

SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; O. C. MARSH, Paleontology; W. K. BROOKS, Invertebrate Zoölogy; C. HART MERRIAM, Vertebrate Zoölogy; S. H. SCUDDER, Entomology; N. L. BRITTON, Botany; HENRY F. OSBORN, General Biology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. McKEEN CATTELL, Psychology; DANIEL G. BRINTON, J. W. POWELL, Anthropology.

FRIDAY, NOVEMBER 15, 1895.

CONTENTS:

<i>The National Academy of Sciences</i>	637
<i>The Thermophone</i> : GEORGE CHANDLER WHIPPLE.....	639
<i>The Foundations of Medical Science</i> : LIONEL S. BEALE	644
<i>The Major Premise in Physical Chemistry</i> : ROBT. B. WARDER.....	651
<i>Remarks on Some Recent Fungi Exsiccati</i> : JOSEPH F. JAMES.....	654
<i>The Bibliographica Zoologica and Anatomica</i>	656
<i>Current Notes on Physiography (XVIII.)</i> :— <i>Mackinder on English Geography; Mountains and Lowlands of Greece</i> : W. M. DAVIS.....	657
<i>Scientific Notes and News</i> :— <i>Harvard College Observatory; The Department of Insects of the U. S. National Museum; The Third International Psychological Congress; General</i>	658
<i>University and Educational News</i>	664
<i>Discussion and Correspondence</i> :— <i>The International Code of Nomenclature</i> : CH. WARDELL STILES. <i>Katydid Orchestration</i> : ELLIOTT COUES, ARTHUR P. BOSTWICK. <i>The Science of Mentation</i> : WESLEY MILLS. <i>Inverted Image Once More</i> : JOSEPH LE CONTE, J. McKEEN CATTELL.....	665
<i>Scientific Literature</i> :— <i>Tenth Report of the Northwestern Tribes of Canada</i> : ALEX. F. CHAMBERLAIN. <i>Solution and Electrol-ysis</i> : THOMAS GRAY. <i>Critical Periods in the History of the Earth</i> : ARTHUR HOLLICK. <i>Eccles' Practice of Massage</i> : GUY HINSDALE.....	668
<i>New Books</i>	672

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Prof. J. McKeen Cattell, Garrison on Hudson, N. Y.
Subscriptions and advertisements should be sent to SCIENCE, 41 N. Queen St., Lancaster, Pa., or 41 East 49th St., New York.

THE NATIONAL ACADEMY OF SCIENCES.

A SCIENTIFIC session of the Academy was held at Philadelphia, in the Laboratory of Hygiene of the University of Pennsylvania, beginning Tuesday, October 29th, 1895, at 11 o'clock A. M. and continuing through the following day.

A special stated session was held on Wednesday, October 30th, to consider the President's Annual Report to Congress and other business.

The members of the Academy reported in attendance were: Alexander Agassiz, Carl Barus, John S. Billings, Henry P. Bowditch, William H. Brewer, W. K. Brooks, George J. Brush, Edward D. Cope, Samuel F. Emmons, Wolcott Gibbs, Theodore N. Gill, Benjamin A. Gould, Arnold Hague, Asaph Hall, Charles S. Hastings, O. C. Marsh, Albert A. Michelson, S. Weir Mitchell, Edward S. Morse, John W. Powell, Raphael Pumpelly, Frederick W. Putnam, W. H. Welch, A. E. Verrill, Francis A. Walker, Horatio C. Wood and Charles A. Young.

The papers presented were as follows:

OCTOBER 29TH.

I. *On the Paleozoic Reptilian Order of the Cotylosauria*: E. D. COPE. Prof. Cope said that the order Cotylosauria is of much interest from the fact that it is one of the two orders of paleozoic age, because it approaches nearest to the Batrachian class, and because it is the ancestral type of all the Amniota Vertebrata. The order was determined by the speaker in 1870, and is now known to include forms from North America, South Africa and Scotland, in the latter country in Triassic beds. Four families and ten genera are known, and

they range from the size of a caiman to that of a lizard.

II. *On a New Variable of Peculiar Character*: S. C. CHANDLER. This paper relates to the discovery of a new variable which appears, from a study of its characteristics, not to belong to either of the two recognized types of variables of short period. It fluctuates between the magnitudes 8.9 and 9.7 in the singularly short period of five hours thirty-one minutes and nine seconds. It is distinctly not of the *Algol*-type, being in continuous variation during its whole period. Its light-curve is also quite unlike that of the other known class of short-period stars, exemplified by γ Aquilæ and δ Cephei, in which the duration of increase and decrease have the ratio of about one to three; since the increase and decrease of this star occupy nearly equal times, the increase being indeed rather the slower. The variations are very rapid, and maxima and minima are equally and sharply marked, both being observable with the same precision with which we are familiar in the stars of the *Algol*-type, namely, within a very few minutes.

III. *On a Bone Cave at Port Kennedy, Pa.*: E. D. COPE. Prof. Cope reported that the cave seems to be in a fissure of limestone, overlaid with red sandstone. It was discovered in 1870, when, after a blasting, a portion of its contents was exposed and examined by Prof. Cope, who then described 40 species of animals found in it.

About 30 feet have so far been examined, and the bottom is not yet in sight. The further down the diggings are made, the richer the find. On a base of clay, strata of vegetable matter, charred earth, wood and leaves, lie strata of crushed bones, powdered very fine, forming almost a meal.

The number of species so far discovered is 43, some of which have not been previously determined. The bones are those of tortoise, snake, birds, sloths, hoofed

mammals and carnivora. Among the last are found the skunk, bear, and four species of the cat family, including allies of the jaguar and tiger. The teeth of several mastodons were found, but no traces of elephant. Very many specimens of jaws of the tapir were discovered, as were also the remains of extinct species of horses, differing considerably from the present horse.

Two specimens of teeth of a peccary, and one of an animal probably resembling the South American llama, were likewise taken from the cave. The tiger tooth is very interesting from the fact that, while the genus appears in the caves of America, it has not been found in Europe.

One of the species of bear resembles the existing black bear, while the other is similar to a rare species found in the Andes and California caves, and is not related to any form now existing in North America.

No remains of man have thus far been found, and the cave is probably the best example of the older caves existing prior to the Champlain epoch, or period of submergence, and after the glacial period. The great problem to be solved is, did man exist in North America prior to the Champlain period? If the remains of human beings are found here it will be of great importance, as the geologic time of this cave seems to be well known.

A stone quarry occupies the site of the cave, and blasting was done by Mr. Kennedy in 1840, but fossil bones were first noted in 1870. The bottom of the quarry is now 45 feet below the top of the hill. The bones lie in red clay, and are finely ground up, with here and there a larger mass. The entrance must have been overhead, and the debris brought from a distance and poured in from the top. No marine shells or other evidences of oceanic life have been found. Great blocks of wood, some of it retaining the bark, and nuts, seeds, grasses and leaves were discovered in the cave.

IV. *On Borings through the Coral Reef in Florida*: A. AGASSIZ.

V. *On the Alkali Uranates*: WOLCOTT GIBBS.

The reports by Professors Agassiz and Gibbs were presented informally in the absence of other papers to occupy the session.

OCTOBER 30TH.

VI. *The Olindiadæ*: W. K. BROOKS.

VII. *New Campanularian Medusæ* (read by title): W. K. BROOKS.

VIII. *The Filar Anemometer*: CARL BARUS. Professor Barus in this paper discussed the sounds by the whistling wind, made whenever air in motion passes across a slender obstacle, like a wire. He showed that the velocity of the wind could be computed from the pitch of the note observed in case of a given diameter of wire and for a given temperature of the air. By aid of a special microphonic attachment such sound could be conveyed to any distance and isolated from the attendant noises at the place of exposure. So represented, the wind was given in every detail of its gusty and variable character, and the term micro-aulmometry seemed to be applicable to observations of this nature. Finally the direction of the gust could be inferred from the sounds obtained from three coördinate wires at right angles to each other.

IX. *The Countertwisted Curl Aneroid*: CARL BARUS. Professor Barus reported that he had investigated the maximum sensitiveness which an extremely thin-walled helical Bourdon tube would show. He pointed out the importance of sharp-edged tubes for the purpose of reducing the flexure of the tube to a case of pure bending, seeing that the products of the principal radii of curvature must then remain constant. He showed that for the same reason the sensitiveness could be enormously increased by untwisting the evacuated coil

with an external spring. Furthermore, if the system of countertwisting spring and helical tube be so chosen that the viscosity as well as the thermal coefficients of viscosity and rigidity of the components are as nearly as possible the same, the system would possess nearly perfect elasticity at all temperatures. The paper was accompanied by a variety of data showing the behavior of simple and countertwisted helices or curls and the remarkable advantages of the latter form.

X. *On the Broadening of Spectral Lines by Temperature and Pressure*: A. A. MICHELSON. Professor Michelson's paper will be printed in the forthcoming number of the *Astrophysical Journal* and will be reported in this journal.

XI. *On the Asteroids* (read by title): A. HALL.

XII. *The Early Segregation of Fresh-water Types*: TH. GILL. [Abstract will be printed in this Journal.]

THE THERMOPHONE.

DURING the recent session of the Summer School of Civil Engineering of the Massachusetts Institute of Technology, held at Keeseville, N. Y., the writer had the pleasure of describing to the students the construction and operation of a new instrument for obtaining temperatures. This instrument, known as a thermophone,* is an electrical telethermometer of the resistance type. It is designed especially for obtaining the temperature of a distant or inaccessible place, but it embodies a principle which may often be used to advantage in scientific work for determining temperatures with greater accuracy than can be obtained with a mercurial thermometer.

The operation of the thermophone is based upon the principle that the resistance which a conductor offers to the passage of an elec-

* Invented by Henry E. Warren and George C. Whipple.

trical current depends upon its temperature, and advantage is taken of the fact that different metals have different electrical temperature coefficients. Thus the resistance of a copper wire increases about one per cent. for each 5° Fahr., while in the case of German silver the increase is only about one-tenth as great. It is a curious fact that the coefficients of most pure metals are almost the same as that of copper, but that alloys have coefficients which are much lower.

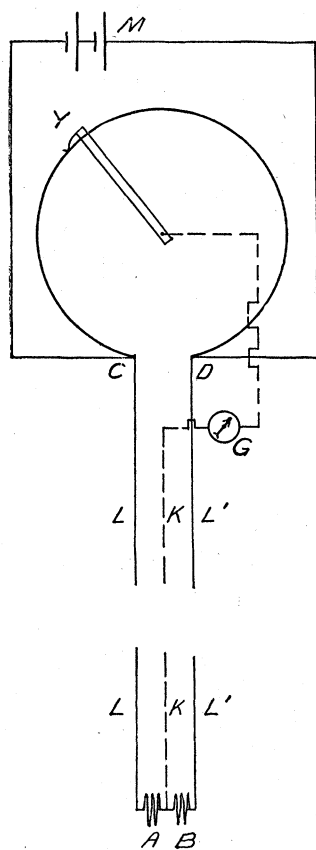


FIG. I.

The arrangement of the electrical parts of the thermophone is shown in Figure I. Students of electricity will recognize it as being a modification of a Wheatstone's Bridge. Two coils of resistance wires, A, B, one of which is copper and the other

German silver, are made to form two arms of the bridge. These two coils are joined together and placed at the point where the temperature reading is desired. They are usually drawn inside a long brass tube of small diameter, coiled into a helix and hermetically sealed, the space between the wires and the walls of the tube being filled with oil to prevent corrosion and to hasten the transmission of heat between the outside of the tube and the resistance wires. The sensitive coils are connected by the leading wires L and L' to the ends of a circular slide wire C, D, and at these points connection is also made with the battery M. A third leading wire, K, extends from the junction of the two coils to a movable contact, Y, on the slide wire. In this circuit there is interposed either a galvanometer or a telephone in connection with a current interrupter, the latter being operated by an independent battery connection. This combination of telephone and current interrupter is used in all the portable forms of the instrument and has been found to be a very cheap and efficient substitute for a galvanometer. The presence of a current is indicated by a buzzing sound in the telephone; silence corresponds to the 'zero deflection' of a galvanometer.

Bearing in mind the principle of the Wheatstone's Bridge it will be seen that the galvanometer will indicate 'zero deflection' when $A:B = CY:DY$. The coils A and B being made of metals having very different temperature coefficients will vary in resistance at different rates as their temperature changes, and consequently there will be a different value of the ratio of A to B for each degree of temperature. Thus it will be seen that with the bridge balanced there must be a different position of the contact Y for every degree of temperature, and a graduated scale may be constructed corresponding to the temperature of the sensitive coils. The slide wire is wound

around the periphery of a mahogany disc, above which is another disc carrying a dial graduated in degrees of temperature. The movable contact which bears on the slide wire is attached to a radial arm placed directly under a hand on the dial, the two being moved together by turning an ebonite knob in the center of the dial. This indi-

the reading of the instrument, for being made of one piece of metal which has the same temperature throughout its length, it will rise or fall in resistance at the same rate on both sides of Y as its temperature changes, and consequently the ratio of CY to DY will not vary. The effect of temperature changes on the leading wires will not

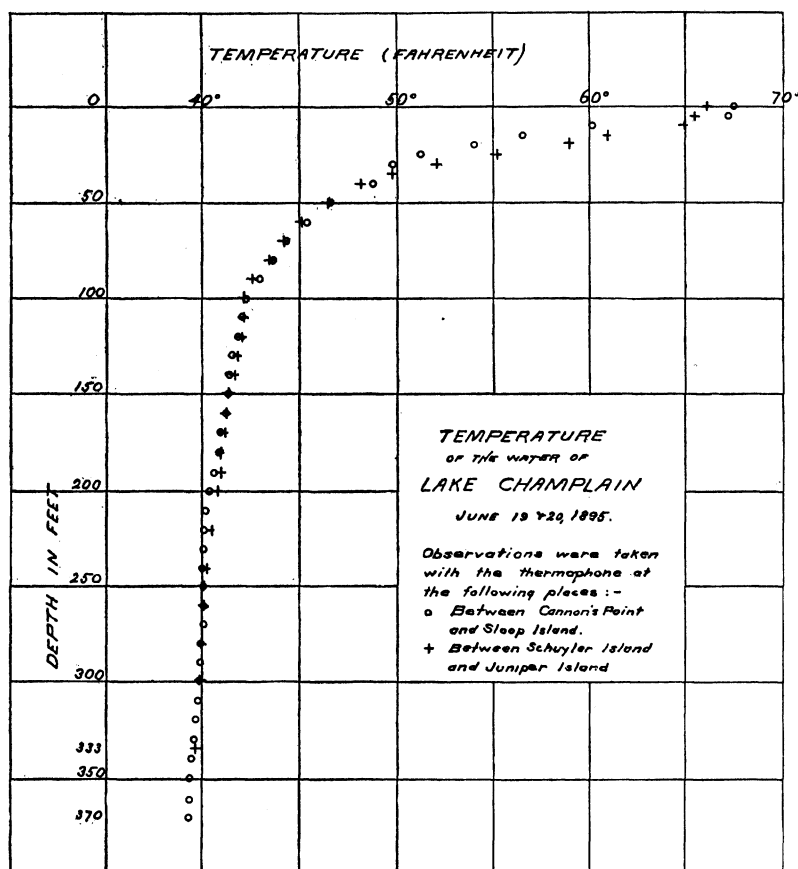


FIG. II.

cator is enclosed in a brass case attached to the box containing the battery, telephone, etc., the box being about 7 inches square and 10 inches high, and furnished on the outside with binding posts for the reception of the leading wires.

It is easily seen that the temperature of the slide wire has absolutely no effect upon

sensibly affect the readings because the two wires L and L' are on opposite sides of the bridge, and consequently balance each other. Compared with the resistances A and B these leading wires are of large size, and in order that they may have the same average temperature they are twisted together and covered with braided cotton.

The operation of taking a reading with the thermophone is as follows: The helix containing the sensitive coils being placed at the point where the temperature is desired, and the leading wires being connected to the binding posts of the indicator box, the current is turned on and the telephone held to the ear. A buzzing sound in the telephone is found to increase or diminish as the hand is made to approach or recede from a certain section of the dial. By moving it back and forth a position may be found where the telephone is silent. When at this point the hand indicates the temperature of the distant coils. The instrument is extremely sensitive. An inexperienced observer may easily set it to one-tenth of a degree. With special instruments having a small range it is possible to make readings with much greater precision.

One of the uses to which the thermophone was put at the Summer School was that of ascertaining the temperature at various depths and at various places in Lake Champlain. A large number of observations were taken. The accompanying diagram, Fig. II., shows the results of two sets of observations taken where the depth was 333 and 396 feet respectively. It will be noticed that below a depth of 50 feet the readings at the two places agreed almost exactly; above that point they differed somewhat, but each curve preserved its regularity. It is interesting to observe how great a change of temperature there was in the first 50 feet below the surface, and how slight a change there was near the bottom. At a depth of 100 feet the water was but 3° warmer than at the bottom.

At the deepest place in the lake, which was found opposite Essex, N. Y., the temperature at 370 feet was 39.35° F., a point only slightly above the temperature at which water is densest. Unfortunately the thermophone wires were not long enough to reach to the bottom, which was 396 feet.

The fact that this temperature so near the point of maximum density was found during the summer season indicates that the water near the bottom is in a continual state of stagnation. It is probable that there is little circulation below a depth of 200 feet.

In passing it is interesting to note the growing interest that is being taken in the study of the temperature of lakes in connection with that of the micro-organisms in the water. The seasonal occurrence of many of these forms which cause trouble in water supplies has been shown to be directly connected with the vertical circulation of the water. Knowledge of the extent and character of these vertical currents can best be obtained by observing the temperature of the water at different depths.

One of the most interesting of the special uses of the thermophone principle is in connection with the accurate measurement of distances by means of a steel tape. Heretofore the greatest objection to the use of a steel stape for the measurement of a base line has been the alterations in its length due to varying temperature and the impossibility of correctly ascertaining its temperature at the moment of use. Thermometer readings taken alongside the tape, or even with the bulb in contact with it, cannot give its exact temperature. Especially is this true when the work is done in the daytime and with the sun shining. For this reason the most accurate work has usually been done at night when the temperature of the tape is substantially the same as that of the air. By the application of the thermophone principle the tape itself may be used as a thermometer and its exact temperature easily determined. This was experimentally demonstrated at the summer school at Keeseville, where the apparatus was used for the first time.

The steel tape, 100 meters in length, was suspended a few feet above the ground between two iron poles which bore an ingeni-

ous device for keeping the tape stretched at a uniform tension. At intermediate points, 10 meters apart, the tape was supported by insulated wire hooks. Parallel to the tape, but insulated from it, a German silver wire was suspended in a similar manner except that the tension was not regulated. At the rear end the tape and wire were electrically connected; at the forward end short flexible leads connected the tape and wire with the slide wire of the indicator. A third wire trailing along the ground, connected the junction at the rear end with the sliding contact of the indicator, having in its circuit the telephone and interrupter. The arrangement was precisely the same as in the ordinary instrument, the tape and German silver wire acting as the sensitive coils. The connections with the tape were made by adjustable clamps which could be easily removed when it was time to carry the tape to a new position. The indicator box was conveniently placed near the forward end of tape, and readings were taken in the ordinary manner by holding the telephone to the ear and setting the hand on the dial to the point of silence. The dial bore two graduations, one showing the temperature of the tape, and the other the linear correction corresponding to the temperature. Thus it was possible, by a single reading taken at the instant when the measurement was to be made, to determine the amount necessary to be added to or subtracted from the length of the tape.

The experiments at Keeseville consisted of the measurement of a base line 900 meters in length and an accurate determination of the coefficient of expansion of the tape. The results showed conclusively that the error from temperature could be reduced to one part in 1,500,000, which was well within the precision of other portions of the work. The coefficient of expansion was determined by two sets of observations,

the results being 0.00000613 and 0.00000615 respectively.

An interesting set of observations was made on the temperature of the tape at a time when clouds were passing over the sun. The rapid fluctuations were astonishing and indicated that the tape was much more sensitive to temperature changes than a mercurial thermometer. At times when a dark cloud would suddenly obscure the sun the temperature of the tape would drop ten or fifteen degrees in half a minute. A complete account of these experiments will be published in due time.

The thermophone has also its practical uses, which are as varied as the uses of a thermometer. For use in connection with the ventilation of buildings it possesses qualities which make it more valuable than the ordinary telethermometer. Besides being accurate and comparatively inexpensive it has this further advantage that any number of sensitive coils may be connected to one indicator. Thus in a large schoolhouse a sensitive coil may be located in each room and the leading wires carried to an indicator in the janitor's office, where, by using a switch board, the janitor may read from one dial the temperature of any room in the building.

In buildings it is advisable to dispense with the telephone and current interrupter and use a galvanometer so arranged that the temperature of the distant coil is indicated by the deflections of the needle. With such an arrangement it is only necessary to press a button in order to have the needle automatically indicate the temperature.

In conclusion, it should be remarked that the thermophone is admirably adapted for obtaining high temperature, *i. e.*, up to 1,500 or 2,000° Fahr., and will doubtless find an extensive use in boilers, chimney flues, etc. It is also the purpose of the inventors to make the instrument self recording.

GEORGE CHANDLER WHIPPLE.

*THE FOUNDATIONS OF MEDICAL SCIENCE.**

THE extraordinary advance which has characterized nearly every department of science during the past fifty years can hardly be said to have helped the solution of that most important of all problems, the very foundation of natural science—the nature of life. To us engaged in the study of disease and the relief of suffering it is—and from more than one point of view—a fundamental question, one which from the earliest times has been regarded by the medical profession with the keenest interest. Time after time scientific enthusiasts have announced in the most confident terms, and for more than forty years the public have been assured again and again, that at last the mystery had been solved or was so near solution that it might be considered as practically settled. Among scientific workers and thinkers, however, the divergence of opinion as to the real nature of life has been, and is, so great that we are still uncertain how any living thing is formed, how it grows, what is the exact nature of many diseases, and in what manner the action of many of our medicines is to be correctly explained; while, notwithstanding great progress in investigation, many morbid changes and phenomena connected with the healing of wounds and the repair of injuries have yet to be cleared up before we shall be able to say that the nature of vital processes is understood. The very foundations—the first principles of all living nature, the exact differences between the living and the non-living state—have still to be established. Even the broad differences between a particle of matter which is actually living and one that has just

ceased to live have not been ascertained, and our physiology, pathology and medical science rest upon no certain basis. Mental operations have received various explanations, but not one that has been offered adequately accounts for the facts, while vague and uncertain data and conflicting interpretations of facts form the foundations upon which uncertain and perpetually changing philosophy has been constructed. So strong, however, is the conviction of some with regard to the truth of the physical doctrine of life, and the generalization that the living and non-living are one, that not a few would modify our systems of government and education in order to bring them into accordance with certain fanciful speculations upon the religion, morality and civilization of the future when physical doctrines shall be universally accepted and taught.

So determined has been and is the set of opinion against the idea of the operation in living beings of anything in its nature distinct from physical or chemical change that I have long hesitated to press a contrary view, notwithstanding that facts and arguments in all departments of living nature give to it very strong support; while, on the other hand, the favorite doctrines still taught are contrary to all living nature, and to make them popular it has been necessary to invent a new nature—a nature which from the first has been shown to be impossible. Lately, however, a change has come over men's views. Not a few have begun to doubt whether the purely physical doctrine of life is supported by facts, and at last the distinguished President of the Chemical Section at the Ipswich meeting of the British Association has dared, not only to express his doubts concerning the purely physical doctrine of life, but has gone so far as to plead 'for a little more vitality.' I heartily join in his plea, and have for many years hoped that ere long we should be per-

* An introductory lecture delivered at King's College Medical School on October 4th, 1895, by Lionel S. Beale, M. B., F. R. C. P. Lond., F. R. S., Joint Professor of the Principles and Practice of Medicine in King's College, London, and Physician to the Hospital.—Abridged from the report in *The Lancet*.

mitted to admit the operation of a vital, constructing, arranging, guiding and regulating power working in everything that has life. I have endeavored to show exactly where this power operates and upon what, and have drawn attention to the fact that the living matter or 'bioplasm' possesses very similar powers in all living things, from the lowest to the highest. For the most part the plea has been in vain, and overwhelming authority has declared for the opposite view, and that those who differ, being weakest, are to go to the wall.

This question of the nature of life forces itself upon our consideration in all our deeper medical and physiological inquiries and in all attempts to decide upon the foundations of natural knowledge. Not only are intellect, thought and the countless workings of the mind inexplicable upon physical doctrines, but the movements and growth of the very simplest living forms are due to far more than is comprised in purely physical and chemical changes. Is not life-power the real, directing, controlling, regulating and selecting agency in every form of the living? How can we accept the proposition that from non-living atoms and their properties is somehow evolved a power which determines the arrangement of these very atoms, which places them in already determined positions, that tears them away from one another and then brings them within the sphere of their influence so that new and totally different substances result? Could watches and engines make themselves, and multiply, regulate and direct, set themselves in motion, and stop when they willed to do so, some comparison might be made between machines and living matter. I feel sure that all intelligent persons will agree with me in thinking that the time has arrived when this matter should be thoroughly reconsidered. The influence of vitality upon matter as a guiding and directing agency—as a

power by which the elements of matter may be torn away from one another, rearranged and caused to recombine in a way unknown to physics and chemistry—has yet to be recognized, and, if possible, investigated. That this power is transmitted from living particles to lifeless ones, which then live, is certain; equally certain is it that all living matter is clear, transparent, structureless and as colorless as pure water. These are the characters of the simple substance in which vital changes are effected without machinery and without any apparatus. This living matter or bioplasm is, I believe, the foundation of all living nature, the seat of all vital phenomena in health and disease, and the only substance in nature possessing powers correctly termed vital. Is there not evidence that in every kind of living matter the elements of the substance that lives may be separated and rearranged in an order determined beforehand, and in such a manner that definite compounds result and structures evidently designed for definite purposes are formed to do certain work? Have any such phenomena been explained by physics and chemistry? Consider whether any machine has been constructed that can perform work and be kept for any length of time in working order without the designing, regulating, managing power of the living mind. Where is the laboratory that performs chemical operations without the chemist? And where is the matter that can be subjected to analytical and synthetical operations without the intervention of some living agency? And yet it has been affirmed again and again that the living cell is a lifeless laboratory, where work of the most complex kind is carried out without any designing, directing or controlling agency whatever. It is often assumed that substances of chemical simplicity are more easily changed in vital action than bodies of great complexity of composition; but so

far as we have evidence complexity and simplicity of composition are equally overcome by living power. The change seems to be carried out in all cases in the most perfect manner, and very quickly. The view of the building up from simple to complex is not justified. The atoms seem to take up their appointed positions and relations as if impelled by an irresistible power, and according to the same principles in every case, from the lowest to the highest organisms.

The members of the profession and all students are to be congratulated upon the addition, during the past three years, of a new subject to those which have long formed the basis of medical education. The careful study of elementary biology must now be taken up by every medical student in the early part of his course. He has to work with the microscope and to become familiar with the use of instruments for delicate research which were not known to the advanced investigators of fifty years ago. Every student acquires real knowledge of the minute structure of the body, and may form his own conception of the general nature of the wonderful changes characteristic of living things, from the lowest organisms to man himself. I hope you have all seen what happens when a particle of living matter, say, of an amœba, exhibits what we call vital movements, and have observed portions moving away from the general mass. Such portions, becoming detached, begin a new and independent life, taking up nutriment on their own account, and growing like the parent organism from which they have been detached, or have detached themselves, and at length increase and multiply and at last die, like all other things that live. Some have affirmed that this living matter is 'like' a mixture of oil and mucilage, but those who have studied practical elementary biology will not be misled by such a 'likeness.' Would that people generally could also

study some of these simple living organisms and learn the differences between that which lives and assimilates, and grows and dies, and that which does not live. No one who had thought over what he had seen would be persuaded to assent to the proposition that the clear structureless living matter should be regarded as a form of machine, molecular or otherwise. When you examined this living matter under a high power I am sure you must have felt astonished that any one could speak of such a thing as a mechanism or as a laboratory. The moving projections or diverticula just alluded to, like those of leucocytes and pus and mucus corpuscles, are well deserving of your further attentive study. Watch carefully the movements and notice how very clear and transparent is the moving matter. In some you cannot discern a single granule even with the aid of the highest powers, and I think when you do see granules and carefully study their movements you will agree with me in the conclusion that it is not in these visible granules that the moving power resides, but that the visible particles are moved by the clear, soft, structureless substance of which the diverticula consist. The process of growth may continue by the taking up of non-living matter by the transparent, moving, living substance and the communication to it of amœba life, through generations. The process has proceeded for thousands of years, but whether an atom of the matter of the parental organism remains, except for a very short time as a constituent part of the detached descendant, seems to rest upon too fanciful a basis to entitle the living changing matter to be regarded as *immortal*. Think over what you have seen and consider how the wonderful movements are occasioned, how the living matter communicates its powers to the non-living and grows and multiplies. Can it be merely chemical change or me-

chanical action that produces the result? When and what is the machinery said to be present, and how is any 'molecular mechanism' to be demonstrated in such transparent substance? *Authority* alone steps forward and insists upon laws and properties and tendencies, declares to us what we are to believe, and prophecies what our successors will discern in the future.

Before the year 1860, after having carried on observations upon the tissues of plants and animals in many departments of living nature, and from the earliest period of development to the fully formed state and into old age, under the highest magnifying powers (from 700 to more than 2000 diameters) and with great advantages as regards the preparation of specimens, I was led to draw a distinction in each tissue, organ or organism between the living growing formative matter and that which had been formed and could not reproduce itself or give rise to more formed matter. I was gradually led to the general conclusion that every form of the living, growing matter was absolutely distinct from every kind of the resulting formed matter produced by it, and, further, that the influence upon the non-living pabulum was peculiar and belonged to all living matter, but to this only, and that it was not comparable with, or allied to, any other known property, power or action of matter. These conclusions were illustrated in detail and were published in 1861. The preparations were shown to my class of physiology in this College and during lectures at the Royal College of Physicians of London, and further discussed in memoirs published in the Transactions of the Royal Microscopical Society and in several works published at that time and since. It seemed to me that there were no indications whatever of the faintest analogy between the two kingdoms of nature—the living and the non-living—no indications of any gradation from matter in the non-

living state to that of life, while all living matter, from the very lowest to the very highest, exhibited certain common characters, being always colorless, structureless, capable of independent movement as a whole or in part, capable of growth, with a power of selecting certain substances and rejecting others, having structural formative power and powers of affecting chemical change, rendering it certain that the origin of matter so endowed was not direct from the non-living, and that this doctrine sooner or later would have to be abandoned. The warmest advocates of the latter view have never given adequate reasons for the faith they professed, or answered the many objections advanced against the conclusions they accepted and taught. All the particles of living matter actively concerned in the formation of tissues and organs, easily seen under a power of 200 diameters, are less, and most of them considerably less, than the $\frac{1}{1000}$ part of an inch in diameter. In the absence of such living particles nothing can be formed or secreted. If we are to form any accurate conception of the actual phenomena which occur when some of the matter of these minute living particles is resolved into tissue or secretion, it is necessary to study the matter very attentively with the aid of the highest powers, and then we can expect only to learn some of the broader changes which occur. The actual conversion probably occurs in particles of matter far more minute than can be discerned with the highest powers at our disposal. Most important facts, however, have been demonstrated with reference to the movements of many of these bioplasts. Where fibrous or other tissues are formed which are to be laid down in parallel lines the fibre is as it were spun off as the particle of living matter (bioplast) moves upwards or downwards along the tissue already formed, and thus fibre after fibre is added to those already existing. In some

tissues the bioplast moves round and round the cell cavity, thus forming concentric fibres or layers. Such bioplasts, evenly distributed through all the tissues and organs of the body, even in the solid bone, take part in the formation of the tissue around, may exist through life and change very slowly in health, most of them getting smaller as age advances. These are instrumental in establishing the passage of fluid to and fro in the interstices of the tissue. By this continual flow the integrity of the tissue is preserved and the occurrence of degeneration is prevented or postponed. Anything favoring the passage of more nutrient fluid than the very small quantity required by these slowly living particles favors their enlargement they live too fast. They increase in size, and this change is constant in every form of inflammation and fever. With the enlargement there is invariably rise in temperature of the surrounding part and of the blood as it traverses the nearest capillaries. When this change, as in fever, affects the bioplasts of many tissues of the body and is widely distributed, the temperature of the whole volume of blood is, as we know, raised several degrees, but falls with the diminution of the febrile symptoms, as the bioplasts return to their ordinary condition. If in ordinary inflammation the process continues and increases, the bioplasts give off diverticula which may be detached, and at last 'pus corpuscles' result, and the adjacent structures are destroyed. In all pathological changes these bioplasts take part. The health of the body depends upon the normal state of the bioplasts, and movement and changes continue while life lasts. Their life is destroyed by many poisons, notably by hydrocyanic acid, the proportion of 1 in 100,000 in the blood being probably sufficient to destroy the life of adjacent bioplasts in a few seconds. You must have seen multitudes of these bioplasts

disseminated through the tissues which you have examined, and have, no doubt, studied their arrangement in different tissues and organs, though, perhaps, from their being perfectly colorless you may not have regarded them as the most necessary part of the organism. Without them no tissue or organ could have been formed, could have preserved its integrity, or, in case of injury, could have been repaired. They are the life of the body, and without them nothing can live; they constitute the living part of the body—that is, the matter that dies. In cases of fever and inflammation, and in various conditions in which there is increased flow and facilitated access to the bioplasm of nutrient matter in any tissue or organ, one sees, after the altered state has lasted for a short time, arising here and there in various parts of the bioplasm minute dots, which gradually become large enough to be seen easily and are known as nuclei. If the process continues some of them become much larger, and in them new points appear (nucleoli). This is an example of true evolution, as the bodies in question are new centers of living matter, which arise in already existing and perfectly structureless bioplasm.

Not only as long as life lasts is the substance of which living matter is composed in constant movement and portions caused to change in position, but the very elements of the matter, however strongly they may have been united in the non-living condition, are caused to separate, and not only are they rearranged, but they are rearranged in a definite and predetermined manner which differs in different organisms and in different tissues and organs of the same organism. Such movements, of course, can only be represented to the mind, since the movement spoken of and the affected particles themselves are far beyond the present range of our vision, assisted as it may be to the utmost with the

aid of very high magnifying powers. The movements we are considering in very minute particles of living matter take a general direction from center to circumference, and the places of those which have taken a centrifugal course are taken up by the pabulum, the flow of which is centripetal. It is, in fact, in these centers, far removed from our powers of vision, that life power seems to be communicated to the matter, and here the non-living matter begins to live. Life causes elements, however strongly combined, to separate, and overcomes the physical and chemical attractions of elements in combination. Life is able to raise particles above one another in a manner not explained. Of the rearrangement of the component atoms of matter, and of the alteration of their relation to one another during the living state, there can be no doubt, but how this is effected has not yet been ascertained. This rearrangement is different in the different kinds of living matter and results in the production of certain special substances, constant as regards living matter of the same kind under the accustomed natural conditions.

So far, then, we seem to have arrived at this, that the matter of the body actually living can be distinguished from the material which is formed by changes occurring in any portion in which vital phenomena have ceased. For instance, in the growing 'cell' of epithelium the central part is structureless and is alive, and its particles can grow and multiply. The outer part has structure, but no longer manifests vital phenomena. It cannot produce matter like itself, or grow, or select nutriment, or exhibit spontaneous movements. Just at the point where the formed material and the living matter touch, particles of the latter from time to time cease to exhibit vital changes, and the resulting products become formed material which is added to that already produced. Such changes occur everywhere

in living organisms, from the first to the last moment of existence, whether 'high' or 'low,' 'simple' or 'complex.' *Vital change* is one thing, physical and chemical change another, and no particle of matter is the seat of these two classes of changes at the same moment. But there are other wonderful powers associated with the living condition, known to all but understood by no one, some of which I shall now briefly refer to. With regard to the marvellous power which a speck of living matter may transmit without loss to descendants during centuries, only think of this: The oldest variety of pigeon, bred for many generations without loss, and perhaps with improvement, of its remarkable characteristics, and bear in mind not only as regards color, form and number of feathers, but widely diverging from its original progenitors as to the characters of bones, muscles, nerves and other tissues; as to habits, manner and disposition, as to powers of flight—in fact, as to many particulars which would lead us to regard it as a true species far removed from the rock pigeon—in short, having little in common with that species—nevertheless carries, apparently fixed and unalterable in its organization, not a new tendency, but an inalienable compulsion if left to nature for its offspring to revert to the ancestral characteristics; not immediately, but after a few generations its descendants exhibit the original specific characters, having lost all traces of the variety which but a few (often only three or four) generations before might have been regarded as a definite species of pigeon. And, further, think of this, that every rock pigeon, generation after generation, has possessed deeply ingrained, as it were, in its organization the power of transmitting to descendants the capacity of giving origin to any or several varieties of pigeon that are known, and perhaps to many more varieties not dreamt of, and at the same time to every variety

the power of reversion to the original species, if only each individual is allowed to choose its mate as in a natural state. Consider the constancy and, on the other hand, the wonderful plasticity of the organization of this familiar but remarkable bird. Contemplate the wonderful power of change from, and the more wonderful power of reversion to, the original type transmitted through generation after generation and retained through centuries, the only medium being a speck of matter so minute that it would not be indicated by a very delicate balance, and tell me whether you think it probable that the powers referred to are due to the original material properties of the fragment of matter concerned, or whether this acts only as a carrier of the marvelous power belonging to the living world only and originating in the infinite. Never before the present time was there any possibility of approaching the thorough investigation of the important question of life. Our much wider range of knowledge concerning the structure and action of many living organisms widely separated from one another has, in fact, enabled us to consider the question from many new points of view; and, although the issue between contending parties is perhaps more pronounced than ever, the probability of arriving at the truth has immeasurably increased, if, indeed, it has not already reached something approaching certainty. It is curious that, although knowledge of minute structure and of the actual phenomena characteristic of living matter has been widely spread, the important question of the nature of life and its resemblance to and differences from all physical and chemical actions known has only been very imperfectly debated. One would think that the inquiry lay far away from the paths familiar to most educated persons, but the most important points bearing upon the inquiry can now be made intelligible to edu-

cated minds without much difficulty, so that many thoughtful persons may be able to form a judgment of their own, at least concerning the direction in which the truth will probably be discovered.

Among the broad and well-known facts, then, not to be explained by the physical view of vital actions is the vast subject of heredity so remarkable in every department of nature, both for the long periods of time of its continuous operation and for the magnitude and enormous importance of the results when considered in connection with the very minute quantity of matter concerned. Is the transmission of characteristics of minute structural details of extraordinary constancy handed down from generation to generation for hundreds or thousands of years by the very minute particle of matter which we know to be concerned in the process to be attributed to the physical properties and chemical composition of the matter involved or to vital power communicated to this from the immediate predecessor?

We have now followed the phenomena common and peculiar to all living to the seat of their activity in living matter. In centers far more central than our present means of investigation will permit us to penetrate living particles communicate, and without loss, their marvellous powers to some of the recently selected molecules of the non-living pabulum. It would seem that now for a time the ordinary properties of matter are held in suspense or are overcome. Here occur analytical operations of the most stupendous kind, which are carried out very quickly and in the quietest manner, without apparatus or reagents, and without resort to a high temperature. The matter which is the seat of these phenomena is as clear as water, structureless, and composed of very few elements which, if the matter dies, easily take the form of an albuminous substance with fatty matter and salts. During the living state the atoms of the mat-

ter, if there be atoms, may be torn from one another and made to take up new and definite relations, so that by synthesis there arise new substances with new properties, perhaps exhibiting structure and capable of performing purposive action of the most striking and at present inexplicable kind; motion, heat, light, electricity, being manifest in certain cases among other phenomena, while there are present no arrangements, conditions or apparatus such as would enable us to develop these independently of the living. Here, then, as it seems to me, will be found the foundation not only of the principles of physiological, pathological and medical science, but of that of the whole living world as distinguished from the lifeless cosmos. Here we must look for the initiation of all the changes characteristic of the living state. Account must also be taken of these peculiarly vital phenomena in discussions concerning consciousness, thought, and will, and the life that has been, is and is to be. And may we not even hope that by further and deeper study of the phenomena of living matter under the new advantages of demonstration which we enjoy, and which are constantly progressing, some further light may be thrown by the increased skill of investigators of vital phenomena even upon the nature and relationship of material atoms in that boundless world of the non-living which ever has been and must be regarded alike by learned and unlearned with wonder and admiration?

LIONEL S. BEALE.

LONDON.

*THE MAJOR PREMISE IN PHYSICAL
CHEMISTRY.**

CHEMISTRY is essentially an inductive science, mathematics is essentially deduc-

* Abstract of a paper prepared by request, to introduce the topic of Physical Chemistry, for the American Association for the Advancement of Science. Read Sept. 2d, 1895.

tive, while physics holds an intermediate position. Yet in our own science, generalizations are reached from time to time, which serve as major premises for syllogistic reasoning. For example, the proposition that each portion of matter has constant weight is at the basis of our knowledge of chemical equivalents as determined by the balance; the isolation of the metals of the alkalis and alkaline earths led to an insight into the nature of salts in general as metallic compounds; and the 'periodic law,' though not expressed in precise mathematical language, is a most fruitful generalization of generalizations.

Physical chemistry, following the logical methods already so largely adopted in physics, is characterized by a readiness to use the major premise. Instead of making a separate experiment to answer each question of fact, the conclusion may often be reached on theoretical grounds, in the same sense as an engineer may demonstrate the stability of the structure he has designed, or the movements of a newly invented machine. What, then, is the leading major premise in modern chemistry? and what shall be the conditions of fruitfulness?

The doctrine of energy, as based upon thermodynamics, embraces the two laws of conservation and correlation; first, energy (while convertible from one form to another) is constant in amount; second, while work may be wholly converted into heat, only a definite fraction of heat can be converted into work. To specify more clearly, if a quantity of heat, H , is received at temperature T (from absolute zero), and if this is converted into work as far as possible by any ideal process until there remains the quantity H' at temperature T' , then the simple theorem holds that the two quantities of heat are proportional to the two temperatures; and of course the difference between heat received, and heat remaining (that is, the work) is proportional to the

difference in temperature. Or, in algebraic language,

$$\begin{aligned} H : H' &:: T : T' \\ H : H-H' &:: T : T-T' \\ \text{Work,} = H-H' &= \frac{T-T'}{T} \cdot H \end{aligned}$$

This equation shows what *fraction* of the heat may be converted into work, under the most favorable conditions; namely, the fall in temperature divided by the absolute temperature at which the heat is supplied.

My present purpose is to present this topic in its bare outlines, and with the greatest simplicity possible. Those who wish to follow the deductive reasoning in detail must use the notation of Calculus, in accordance with the following steps. Combining the formula for the total work (as implied in the first law) with that for work derived from change of temperature (the second law) we deduce a differential equation for the work obtained or required in isothermal changes. The change under consideration may involve external work, as when a vapor or gas is generated against atmospheric pressure; or it may be internal work of different kinds, as when the molecules are endowed with increased kinetic energy in volatilizing, or when a compound is decomposed into its constituents, with increased potential energy.

A somewhat difficult but important paper by J. Willard Gibbs* treats of the equilibrium of heterogeneous substances, giving deductions from the two laws of thermodynamics, which in turn become major premises for a host of further deductions; so broad, indeed, are the propositions of Gibbs, that the distinctions between chemistry and physics do not appear; there may be two 'heterogeneous substances' of like chemical nature, as water and its vapor;

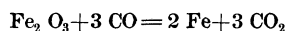
*Trans. Conn. Acad., 3, 108, 343 (1874-78). See, also, Amer. Jour. Sci. [3] 16, 441 (1877); 18, 277 (1878).

there may be three chemical bodies, as limestone with the lime and the carbon dioxid obtained by ignition; or there may be several physical mixtures, as solution of water in ether, solution of ether in water, and the mixed vapor resting upon both liquids. Now, a little consideration will show the importance of knowing when equilibrium is established, for this is equivalent to saying that no further action can take place; the solution is saturated, no longer acting upon the salt; or the gas which has been generated under pressure is no longer evolved. When a change takes place spontaneously, as when I drop a stone, or mix sulphuric acid with water, heat is developed from some other form of energy. To reverse the process, work must be done. The conversion of heat into work is limited by natural law; when a given change implies the doing of work, and that work is forbidden by the terms of our major premise, the change is impossible, equilibrium prevails.

'Osmotic pressure' in dilute solutions is analogous to the pressure of gases; the Gay-Lussac-Marriotte law, with slight modification of terms, applies to molecules in the liquid state. If work is required to diminish the volume of a gas by means of pressure, work is likewise required to diminish the volume of a body in dilute solution, whether the solvent be removed by evaporation or by freezing. Boiling point and freezing point of the solvent are changed by the presence of the dissolved body. The agreement of observed facts with theoretical deductions has led to important methods of determining molecular weights, while the apparent discrepancies in the case of electrolytes have proved an important argument for the doctrine that these compounds are dissociated into their ions.

Our Chairman has pointed out the mutual indebtedness of technology and pure

science. Manufacturing processes afford many examples of change which are not carried to completion; it is important to know how far the operation can be improved to afford a larger yield, a purer product or less waste. Combustible gases issue from the blast furnaces. There is still a great reducing power in this mixture of carbon monoxid with carbon dioxid. Can it be utilized by enlarging the furnace? Immense furnaces were built in order to secure a larger yield of iron, but the results were disappointing. The law of mass action shows that the equation



is limited by certain conditions of equilibrium, and that the ratio of the two oxids of carbon could not be greatly improved over that already secured in practice. The expense of a technological experiment might have been saved, had the indications of mathematical chemistry been heeded.

What hopeless confusion seems to prevail in our present knowledge of solubilities; yet how important in the separations required for chemical analysis. Here, again, we deal with questions of equilibrium. Will work be done at the expense of heat or not?

There are two special difficulties in the general application of thermodynamical principles; first, the minor premise is often wanting; and, second, the mathematical form of reasoning is often difficult for the best laboratory workers. Among the published data of thermo-chemistry, some have been determined directly, some indirectly; it is often difficult to find the data desired or to judge of their accuracy. A critical compilation of all available thermal data, conveniently arranged for reference, with at least some indication of the probable errors, would be very desirable. Many such data might be computed indirectly from experimental determinations of equilibrium.

Many empirical equations have been computed, showing solubility as a function of temperature. Who will trace the correlation among such, and thus add a large chapter to thermo-chemistry? What genius shall discover that form of mathematical function that shall substitute rational for empirical equations with a clear interpretation for each constant required? "But this work is mathematical rather than chemical," you will say. Yes, it is applied mathematics; and mathematicians (not being chemists) are not likely to undertake such a task for us, unless we ask their counsel and aid. Specialization is inevitable; yet by too arbitrary a specialization, we may inadvertently lose the very help we need. Again would I emphasize the fruitfulness which follows a 'cross-fertilization of the sciences.*' Judging from the advances recorded in late years, especially in the '*Zeitschrift für physikalische Chemie*,' it is safe to predict great developments for the rising generation. I heartily echo the sentiment that we need more data; yet great stores of observations upon record have not yet been coördinated and put to use. Ostwald, desiring to know the influence of free iodine upon a reduction process, made three series of determinations (twenty-four in all) from which he concludes that the influence is *not* proportional to the mass. It was no part of his purpose to discover what the law of retardation is; but others might well follow out this clue, using also the data supplied by Meyerhoffer, and supplementing these with further experiments if needed. A glance at the literature of solubilities, and the lack of rational formulas to express broad generalizations, may convince us that a great mine, with abundant ore 'in sight,' is awaiting development; or, rather, that ore has been run through a stamp mill to extract half the gold, while fully half still remains in

* Jour. Amer. Chem. Soc. 15, 601 (1893).

the tailings, awaiting more perfect methods of treatment.

Much may be learned from the systematic habits of the astronomer, dividing his work among the several observatories in a spirit of helpful coöperation, and assigning the labor of computation to those who are fitted thus to follow the lead of others. What better service can we do for the University student than to set before him some of the problems in mathematical or physical chemistry that require patient toil, and give him the pleasure of assisting in their solution by the use of logarithms and squares? What is more practical than to utilize any service he can render?

In conclusion, I beg leave to suggest the appointment of a joint committee (representing Sections A, B and C of the American Association) to consider the feasibility of striving towards the following ends:

1. The compilation of all reliable data of physical chemistry in convenient form for reference, distinguishing those determined directly from those calculated indirectly.
2. The calculation of empirical formulas, to combine any series of data, when some better form of generalization is not already at hand.
3. The preparation and use of rational formulas, wherever possible, to deduce the natural constants from series of observations, and to express the conditions that may be expected to hold between observations of different kinds.
4. The organization of a band of volunteer compilers and computers from among advanced students, who (with the counsel and aid of their instructors) may assist in the work of compiling data and computing formulas.

☞ While the time did not seem ripe for the appointment of such committee at the late meeting of the A. A. S., the writer would be pleased to receive any further

suggestions from those interested, regarding the points noted above.

ROBT. B. WARDER.

HOWARD UNIVERSITY, WASHINGTON, D. C.

REMARKS ON SOME RECENT FUNGI EXSICCATI.

It is still a favorite mode among mycologists to distribute exsiccati, or series of specimens of fungi collected from time to time by various persons and in different localities. In times past these exsiccati have served a very useful end in enabling collectors to acquaint students with any new discoveries, and it has not been unusual to find many new species described in them. Even at the present day this habit prevails to a greater or less extent, and diagnoses of new species frequently occur in these collections. In the writer's mind, however, the custom, although sanctioned by long usage, is reprehensible, especially in those cases in which the species are not also described in some botanical journal. At a period when such journals were few, and when their circulation was limited, the distribution of exsiccati with these new species was justifiable; but now, with the great increase in means of publication and the facilities for illustration, the necessity for this has passed away. It is, indeed, questionable whether such species can be regarded as published in the strict sense of the word. Exsiccati are from their very nature ephemeral. They are easily destroyed by insects and other pests. They have no place on the shelves of the library. They are very limited in their circulation, and their limited numbers and relatively high price practically place them beyond the reach of the majority of students. Only a small number of persons, therefore, have access to them, and they must be sought for in the larger herbaria of the country. The majority of botanists are therefore seldom cognizant of the new species described in

these exsiccati. In many cases the specimens are distributed in the general herbarium as fast as they are received, and unless some record be kept of the new species they are soon lost to view in the great mass of specimens in the herbarium. The duplication of names has been a frequent result of this practice, and it is greatly to be desired that it cease. Let new species be described in regular standard publications, so that the majority rather than the minority of students will know of them.

Among the older distributions is that of Sydow, *Uredineæ*. This has now reached Fascicle XIX., Nos. 901-950. In this the genus *Puccinia* is the best represented, no less than 25 out of the 50 specimens belonging to it. Among them we note *P. simplex* (Körn.) Eriks. & Hen., which is a duplication of *P. simplex* Peck, 1881. (34th Ann. Rept. N. Y. State Mus. Nat. Hist., p. 45.) The old plan of writing the labels instead of printing them is pursued, to the great detriment of the appearance of the specimens and to the annoyance of those who attempt to decipher the names. We would recommend that a change be made in this regard.

The newer distribution of Jaczewski, Komarov and Tranzschel, *Fungi Rossicæ*, has reached its second fascicle, Nos. 51-100. It is interesting in that it contains many specimens from little known or explored regions of eastern Russia and of Siberia. The specimens are neatly put up and have well printed labels.

Fascicle No. IX. of Seymour & Earle's *Economic Fungi* bears date of July 1, 1895, and consists of Nos. 401 to 450. It is made up of parasites on garden vegetables and fruit trees, and does not contain any special novelties unless it be the new hosts of *Plasmodiophora brassicæ* lately recorded by Halsted (Bull. Torr. Bot. Club, XXI., 76, 1894).

The latest arrivals are Fascicles IX. and X. of *Fungi Parasitici Scandinavici*, by

Eriksson. These come from the interesting region of northern Europe. They are accompanied by an index to the ten fascicles, in which are given the names, numbers and hosts of all the specimens distributed. Fascicle IX. (Nos. 401-450) is devoted entirely to the *Uredineæ*, all but two being species of *Puccinia*. *P. graminis* is represented by 19 specimens, several being given 'form' names. Two new species are described, viz., *P. pygmæa* and *P. milii*. Fascicle X. (Nos. 451-500) is also largely devoted to *Uredineæ*, although some other orders are represented. Three new species are described. As it is believed that a useful purpose will be served by the publication of these descriptions they are given below from the original labels.

449. *PUCCINIA PYGMÆA* Eriksson, n. sp.

Uredosporæ in soris minutis, oblongis, lineariter ordinatis, interdum confluentibus, aurantiacis, cum paraphysibus apice globoso-inflatis. Sporæ globosæ, 17-28 μ , aculeatæ. Paraphyses 48-80x11-16 μ . Teleutosporæ in soris minutis, oblongis, linearibus, tectis, atrofusis, hypophyllis. Teleutosporæ clavatæ, apice explanatæ vel lateraliter apiculatæ, medio vix constrictæ, 35-42x11-14 μ .

Sueciæ in foliis *Calamagrostis epigæi* ad Borgholm, in portu, July 20, 1894.

450. *PUCCINIA MILII* Eriksson, n. sp.

Uredosporæ in soris oblongis solitariis vel lineariter ordinatis in maculis flavis foliorum, aurantiacis, cum paraphysibus apice globoso-inflatis. Sporæ globosæ, 19-24 μ aculeatæ. Paraphyses usque ad 64 μ . Teleutosporæ in soris aggregatis, oblongis, tectis, atrofusis, hypophyllis. Teleutosporæ clavatæ, apice explanatæ, 27-41 μ longæ, cellula basalis 13-14 μ , terminalis 12-19 μ lata.

Sueciæ in foliis *Milii effusi* ad Experimentalfältet, (Sjöstugan), Stockholm, September 23, October 8, 1894.

494. *ASCOCHYTA PUCCINIOPHILA* Starback, n. sp.

Perithecia solitaria vel sæpissime 3-7 gregaria, hypophylla, maculis elevatis, pallide fuscidulis insidentia, epidermide elevato cincta, 100-120 μ diam. Sporulæ fusoides-lanceolatæ vel interdum oblongæ, diu continuæ, demum medioseptatæ, vix constrictæ utrinque appendiculis brevibus acutiusculis præditæ, 8-12x2-3 μ .

Intime intermixta crescit *Puccinia polygoni*.

Sueciæ in foliis Polygoni amphibii in insulis lacus Glottern, par Quirlinge Östergötland, August, 1891.

488. DIDYMARIA AQUATICA Starback, n. sp.

Maculæ varia forma, sæpissime suborbiculares, confluentes, amphigenæ e fusco griseæ, fuscomarginatæ. Hyphæ non manifestæ. Sporulæ rectæ, fusoidæ, utrinque obtusiusculæ, 10-19x4-5 μ .

Sueciæ in foliis Alismatis plantaginis in lacu Glottern, Qvillinge, Östergötland, August, 1891.

500. HETEROSPORIUM PROTEUS Starback, n. sp.

Cæspitulæ hypophyllæ, laxæ gregariæ in maculis aridis foliorum insidentes, hyphis fasciculatis, interdum ad basin conglutinatæ stipitemque formantibus, compositæ. Hyphæ 95-100 μ long, 4.5 μ , 6.5 μ crassæ. Conidiæ e nodulis hypharum oriunda, et forman et magnitudine nem valde varia, cylindræa vel cylindræa-ellipsoidea, 3-septata 16-24x4.5-8 μ , 2-septata 14-15x6-7 μ , 1-septata 9-15x3-7.5 μ vel globosa, quæ rarissime adsunt, 5-6 diam., autem conspicue et densissime echinulata.

Heterosporio echinulato (Berk) Cooke affinis modis sporidiorum aliis notis exceptis, hæc species dignoscenda.

Sueciæ in foliis Querci sp. in Upsala, October, 1891.

JOSEPH F. JAMES.

THE BIBLIOGRAPHICA ZOOLOGICA AND ANATOMICA.

At the Baltimore meeting of the American Society of Naturalists (Dec. 1894) a committee was appointed to consider Dr. H. H. Field's plans for bibliographical reform, the committee to report in print. That committee would report as follows:

Dr. H. H. Field, in view of the well-known imperfections and shortcomings of all existing records of zoological literature, has formulated plans which will give the zoological world an approximately complete index of all current literature as promptly as possible. This record will be issued in the form of bulletins, each number of which will be distributed as soon as sufficient material has been accumulated to make a 'signature.' The same bulletin will also be issued printed only on one side of the page, to allow for cutting up for special bibliographies. Lastly, the separate titles

will be issued upon cards of the standard 'index' size. Each title will be followed by a few words giving the subject and scope of the article, when this is not sufficiently indicated by the title, while the cards will have, in addition, catch numbers, so that any library assistant can readily incorporate them in the card catalogue.

The plan contemplates a union of existing bibliographies with this one. In the case of the 'Naples Jahresbericht' this will be brought about by coöperation, the Naples series continuing practically as the yearly morphological analysis of the Bibliography. It is to be hoped that the 'Zoological Record' will consent to coöperate in a similar way, devoting itself to the systematic side, and by aid of the new facilities of coöperation increase its present usefulness to students. Arrangements have now progressed so far that it seems probable that the records of literature in the Zoologischer and Anatomischer Anzeigers will be merged in the new scheme, and it is hoped that the one in Archiv für Naturgeschichte will take the same course. If sufficient encouragement be given, it is proposed to include physiology in the scope of the new plan. The net gain will be fewer bibliographies, wider scope, nearer approximation to completeness, and more prompt publication.

The central office of the work will be established at Zürich, Switzerland, and it may be said that the cantonal government has already appropriated 2000 francs annually to its support, and will supply suitable quarters for its work. France has promised a similar sum, and aid is expected from Germany, from the International Congress of Zoologists and from the British Association for the Advancement of Science. Committees have been appointed in France, Germany and Russia to coöperate in making the record as complete as possible. Lastly, publishers stand ready to undertake the publication of the bulletins, cards, etc.,

without expense to the central office, since the sales are estimated to fully cover all cost of manufacture. The only matter unprovided for is that of preparing the Record for the printer, and this is already so far provided for that if America can contribute \$500.00, the beginning of the work with the year 1896 can be assured.

Your committee, having examined the matter in detail, would, therefore, report that they regard the plan as one worthy the fullest support of the American scientific world. They recommend it as worthy of financial support and would urge all publishers and publishing institutions to send all periodicals and other works (or in the case of books at least the correct title and a summary of contents prepared by the author) promptly to the central bureau. They would finally recommend the appointment of a permanent committee of ten to coöperate with similar committees in other countries in forwarding the movement.

(Signed) SAMUEL H. SCUDDER,
H. P. BOWDITCH,
HENRY F. OSBORN,
E. A. ANDREWS,
J. S. KINGSLEY,

Committee.

Since the above report was drawn up substantial progress has been made. The funds desired from America have been obtained: \$250 from the Elizabeth Thompson Fund, \$250 from the American Association for the Advancement of Science and \$50 from the American Society of Microscopists. Arrangements have been concluded for the publication of a '*Bibliographica Zoologica*,' as a continuation of the 'Litterateur' of the *Zoölogischer Anzeiger*, and a '*Bibliographica Anatomica*,' to contain the morphological articles. The price of the *Bibliographica Zoologica* will be 15 Marks yearly. It will be published by Engelmann, of Leipzig. The price of the *Anatomica* has not been settled. Cards

containing the titles will be issued at from \$2.00 to \$3.00 a thousand, according to the number taken. Arrangements are now in progress for the inclusion of physiology in the plan, and steps have already been taken looking to the later incorporation of botanical literature.

CURRENT NOTES ON PHYSIOGRAPHY (XVIII.).

MACKINDER ON ENGLISH GEOGRAPHY.

THE address to the geographical section of the British Association last summer by Mackinder, reader in geography at Oxford, reviews the progress of the science in general, with especial reference to its advance in Germany. The still low position of geographical instruction in England is lamented, in contrast with its promotion on the Continent. There "some of the professors, as Richthofen, of Berlin, and Penck, of Vienna, have worked mainly at geomorphology; others, such as Krümmel, of Kiel, at oceanography; others, again, such as Ratzel, of Leipzig, at anthropography; while Wagner, of Göttingen, has been conspicuous in cartography, and Kirchhoff, of Halle, and Lehman, of Münster, in questions of method." In England, on the other hand, while an historical or classical student listens to a dozen different teachers at Oxford or Cambridge, a single lecturer at each university is charged with all geography. This wide subject has no appreciable position in degree examinations; there are no examinations at all for the post of secondary teacher, nor is there anywhere in the land anything really comparable to the German geographical institutes that form so important a part of the geographical equipment in certain universities.

The recognition of Mackinder's work in his election to preside over the geographical section of the Association is, however, an indication that even Englishmen are beginning to recognize that geographers, both explorers and teachers, need serious and

systematic training. In commenting on the proceedings of the geographical section, *Nature* says (October 3): "The characteristic of the meeting was the exceptionally scientific value of the papers, which dealt less with exploration than with research."

MOUNTAINS AND LOWLANDS OF GREECE.

PHILIPPSON continues his studies of classic ground (*Reisen und Forschungen in Nord-Griechenland*, *Zeitschr. Gesell. f. Erdk.*, Berlin, xxx, 1895, 135-225; geol. and topogr. maps), telling of his journey along bad roads over half-barren mountain ridges, where the slopes are washed by intermittent torrents which carry gravel down to the valleys and bays. Settlements are chiefly found on the alluvial plains thus formed. Near the mountain foot the plains are stony and barren; further toward the sea the detritus is finer and fertile. This note suggests a reference, even if somewhat belated, to Philippson's work on Peloponnesus (Berlin, Friedländer, 1892, 643 p., geol. and hypsom. maps). The most striking physiographic features of Greece are there summarized; a varied relief of apparently confused changes from short ridges to deep depressions, from steep gorges to basin-like plains. This confusion results from the occurrence of complex zones of faulting in a previously folded mountain structure, producing a very diversified system of divides and water courses. There is no culminating range; no dominating divide, no extended valley trough; but, on the other hand, there is a large number of individual areas, not hermetically separated, but yet sharply divided (453-455). Many of the striking relations between form and history are pointed out. Geological structure, topography and climate are discussed with much care. The extraordinarily irregular coast, along which the sea penetrates far into the land, is due to a general depression of the region. The prevalence of 'potamogenous'

—river-formed—coast lines is shown to be dependent on the protected character of the shore, into whose quiet waters the steep torrents wash the waste from the mountains, building the land out into the sea.

W. M. DAVIS.

HARVARD UNIVERSITY.

SCIENTIFIC NOTES AND NEWS.

HARVARD COLLEGE OBSERVATORY.

It is announced by Prof. E. C. Pickering that for some years the need has been felt at the Harvard College Observatory of some means of making a more prompt announcement of the results of its work. It is proposed, therefore, to issue a series of circulars, as required, to announce any matters of interest, such as discoveries made, the results of recent observations, new plans of work, and gifts or bequests. It is not proposed to give these circulars a wide distribution, but rather to use them as a means of bringing new facts to the attention of the editors of astronomical and other periodicals, and thus secure the immediate publication of such portions as would be of interest to the readers of these periodicals. The distribution will be made without charge to such persons as will be likely to use the results.

THE first of these circulars, issued on October 30th, is on 'A New Star in Carina.' From an examination of the Draper Memorial photographs taken at the Ariquepa Station of the Observatory, Mrs. Fleming has discovered that a new star appeared in the constellation Carina in the spring of 1895. A photograph, B 13027, taken on April 14, 1895, with an exposure of 60 minutes, shows a peculiar spectrum in which the hydrogen lines $H\beta$, $H\gamma$, $H\delta$, $H\epsilon$ and $H\zeta$ are bright, and the last four of these are accompanied by dark lines of slightly shorter wave-length. A conspicuous dark line also appears about midway between $H\gamma$ and $H\delta$. A comparison of the spectrum of this star

with that of Nova Aurigæ and Nova Normæ show that all three closely resemble each other and are apparently identical in their essential features. Another photograph taken on June 15th with an exposure of 60 minutes shows a change in the spectrum of this object. The hydrogen lines $H\beta$, $H\gamma$ and δ are still bright, although the continuous spectrum is very faint. Another line whose wave-length is about 4700 is here as bright as the hydrogen lines. On the photograph taken on April 14th it is barely visible.

An examination was next made of all the photographs of the region containing this star. On sixty-two plates, the first taken on May 17, 1889, and the last on March 5, 1895, no trace of the star is visible, although on some of them stars as faint as the fourteenth magnitude are clearly seen. The exposures of these plates varied from 10 to 242 minutes. On nine plates, the first taken on April 8th and the last on July 1, 1895, the star appears, and its photographic brightness diminishes during that time from the eighth to the eleventh magnitude. This star precedes A. G. C. 15269 (photometric magnitude 5.47) $0^m.5$, and is $0'.7$ north. Its approximate position for 1900 is therefore in R. A. $11^h3^m.9$, Dec. $-61^\circ 24'$. Two stars of the eleventh magnitude are near the Nova. One is nearly north, $110''$ distant, the other is $80''$ south preceding.

THE DEPARTMENT OF INSECTS OF THE U. S. NATIONAL MUSEUM.

THE staff of the Department of Insects of the U. S. National Museum has been reorganized as a result of the sad death of the former honorary curator, Professor C. V. Riley.

The reorganization has been effected by the appointment of Mr. L. O. Howard, entomologist of the U. S. Department of Agriculture, to the position of honorary

curator of the Department of Insects; of Mr. Wm. H. Ashmead to the position of custodian of Hymenoptera, and Mr. D. W. Coquillett to the position of custodian of Diptera. All museum custodians are honorary officers. Mr. M. L. Linell will remain as general assistant to the honorary curator.

The Department is at present in excellent working condition. It contains a very great amount of material in all orders, and in many unusual directions surpasses any collection in the country. Among others the following are of especial interest:—

1. The large collection, in all orders, of the late Dr. C. V. Riley.
2. All of the material gathered during the past 18 years by correspondents, field agents and the office staff of the division of entomology, U. S. Department of Agriculture.
3. The greater part of the collection of the late Asa Fitch.
4. The large collection, in all orders, of the late G. W. Belfrage.
5. The collections in Lepidoptera and Coleoptera made by Dr. John B. Smith down to 1889, together with the types of the Noctuidæ since described by Dr. Smith.
6. The collection of Lepidoptera of the late O. Meske.
7. The collection of Lepidoptera of G. Beyer.
8. The collection of Coleoptera of M. L. Linell.
9. The bulk of the collection, in all orders, of the late H. K. Morrison.
10. The collection of Diptera of the late Edward Burgess.
11. The type collection of Syrphidæ made by Dr. S. W. Williston.
12. The collection of Ixodidæ of the late Dr. George Marx.
13. The collection of Myriopoda of the late C. H. Bollman.
14. Sets of the neo-tropical collections of Herbert Smith.

15. The collection of Hymenoptera of Wm. J. Fox.

16. The collection of Tineina of Wm. Beutenmuller.

17. The large Japanese collection, in all orders, of Dr. K. Mitsukuri.

18. The African collections, in all orders, of Dr. W. S. Abbott, Wm. Astor Chanler, J. F. Brady, the last 'Eclipse' expedition to West Africa, and of several missionaries.

19. The large collection from South California of D. W. Coquillett, in Coleoptera, Hymenoptera, Lepidoptera and Orthoptera.

20. The Townend Glover manuscripts and plates.

In addition to this material, there are minor collections which have been the result of the work of government expeditions, or are gifts from United States Consuls and many private individuals.

This enormous mass of material is being cared for by the active and honorary force of the Department, and the perpetuity of the collection is assured. The National Museum building is fire-proof, and this, together with the fact that it is a National institution, renders the Department of Insects perhaps the best place in this country for the permanent deposit of types by working specialists in entomology, and for the ultimate resting-place of large collections made by individuals.

The policy of the Museum at large, with regard to the use of its collections by students, is a broad and liberal one. Students are welcome in all departments, and every facility is given to systematists of recognized standing.

THE THIRD INTERNATIONAL CONGRESS OF PSYCHOLOGY.

THE third meeting of the Congress will be held at Munich, in the Royal University, from August 4th to 7th, 1896, under the presidency of Professor Carl Stumpf, of

Berlin. Professor Lipps, of Munich, has been appointed vice-president and Dr. Frhr. von Schrenck-Notzing, secretary.

The list of members of the International Committee of Organization includes the names of well-known specialists in psychology from England, Scotland, France, Belgium, Germany, Switzerland, Russia, Italy, Denmark and the United States. The languages used at the Congress may be German, French, English and Italian. The length of papers to be presented before the Congress is limited to twenty minutes.

The program is divided into four parts, as follows: I. Psycho-physiology. II. Psychology of the Normal Individual. III. Psycho-pathology. IV. Comparative Psychology. The preliminary announcement of the Congress which has just been issued, and from which we have taken the above particulars, contains the following request which is worth verbatim quotation.

"Please propagate this program and publish it in all journals.

"Membres, who intend to lecture at this Congress are asked politely to announce their themes and to send extracts of them to the Secretary's office (Munich, Max-Joseph street 2) before the 15. of Mai 1896.

"For themes announced after the 15. of May the committee cannot pass its word for admittance. It is much to be recommended to give orders for lodgings in advance, because at the beginning of August the hotels of Munich are very much occupied.

"Arriving members of the Congress may inquire at the station after the bureau of the 'Verein zur Förderung des Fremdenverkehrs,' and they will willingly get all informations about hotels, pensions and privat lodgings to be well recommended.

"The Secretary's office is stationed from the 3. of August during the congress at the royal university (Ludwigstrasse 17)."

The subscription to the Congress is 15

Marks. The meetings are open not only to psychologists, but to all interested in the progress of psychology.

GENERAL.

A RECENT Bulletin (No. 119) of the U. S. Geological Survey by Mr. G. H. Eldridge describes the area in northwestern Wyoming that lies immediately south of Montana and some distance east of the Yellowstone National Park. It is occupied by the Wind River and Big Horn River basins, and is chiefly covered by the Wasatch and Bridger strata of the Eocene, by Cretaceous and Jura-Trias, with minor areas of Carboniferous, Silurian, Cambrian, Archean and eruptive rocks. The region has long been a fruitful source of Eocene vertebrate fossils, and in its northwestern portion is now an important center of coal mining, as it has rail connections. Mr. Eldridge gave these matters of mineral resources especial attention, and after a geological sketch, based on a colored map, he takes up the following topics: Coal, with numerous analyses and cross-sections, petroleum, building materials, gold, hot springs and agriculture. The bulletin extends our knowledge to an area about which little detailed information had been previously available.

DURING the past summer Dr. Leonhard Stejneger, while at Bering Island, was fortunate enough to secure some bones of Pallas' Cormorant at the locality where he had found others in 1882. At the time these were the only known bones of this extinct species. Among the more recently obtained specimens is a fairly complete cranium which is somewhat larger than that of any existing species, and is peculiar in the character of the ethmoid and opening in the front part of the cranium. Mr. Grebnitski has also procured some remains of Pallas' Cormorant from the same deposit.

THE Library Bureau of London has in-

augurated a Publishers' Central Showroom, to which most of the great English publishers will send all of their publications for inspection. To give the collection the character of a permanent exhibition and divest it of all the appearance of advertising, no books will be sold at the showroom and no orders taken.

PART 6 of Minnesota Botanical Studies is entirely given to Miss Josephine E. Tilden's Bibliography of American Algae. No less than 1,544 titles of papers are listed, although the work professes to be but a preliminary survey of the literature. This is one of the most complete and valuable pieces of special bibliographic work yet prepared for American botany.

IN addition to the teaching botanical garden of the University of Pennsylvania, which has recently been greatly improved and enlarged under the direction of Professor Macfarlane, the University will have the scientific management of Bertram's Gardens, which have recently been made one of the city's parks.

A MEETING of the directors of the Marine Biological Laboratory of Wood's Holl was held in Boston on November 7th. It was reported that the attendance during the past summer had been large and that there had been an increase in the number of the coöperating educational institutions. Gifts had been received by the treasurer during the year amounting to \$2,348. The laboratory is to a certain extent self-supporting, but subscriptions are needed for enlargements and to provide salaries for the officers and instructors.

IN a paper on 'The Stone Industry in 1894,' extracted from the recent report of the Director of the U. S. Geological Survey, Mr. W. C. Day passes in review the industries in granite, marble, slate, sandstone and limestone. An introductory discussion precedes each one, which affords both de-

scriptive and statistical information. The quarries are then taken up by States and much that is valuable for reference is placed in convenient and readily accessible form.

WE have received at this somewhat early date the number for January of a new semi-monthly medical journal *Pediatrics* published in New York and London, and edited by Dr. Geo. A. Carpenter, with an editorial staff including Professor A. Jacoby, of Columbia College, and other leading students of the diseases of children.

PROFESSOR L. L. DYCHE, of the University of Kansas, has returned from a six months' absence in the Arctic regions as a member of the Peary Relief Party. He has brought back to the University a valuable collection of skins and skeletons. With the exception of the musk-ox, Prof. Dyche has now personally secured a specimen of every known North American Arctic mammal.

SOME of the friends of the late Professor Sir Thomas Francis Wade propose to raise and offer to the University of Cambridge, a sum of money sufficient to provide for the construction of a catalogue of the large and important collection of Chinese literature which during his lifetime he presented to the University Library.

BRUSSELS is to be connected with the sea by a new canal, allowing vessels of 2,000 tons burden to reach the city, the estimated cost of which is 35,000,000 francs. The official name of the city will hereafter be 'Bruxelles Port de Mer.'

THE mortality from diphtheria in London has greatly increased recently. During the week ending October 19th the number of deaths was nearly double the average for the corresponding week of the ten preceding years 1885-94.

THE Carnegie Music Hall, Museum, Art Gallery and Free Library given by Mr. Andrew Carnegie to the city of Pittsburg,

was formally dedicated on November 5th. The gift of the building and library is accompanied by an endowment of \$1,000,000. Mr. Carnegie's gifts to the cities of Pittsburg, Allegheny, Braddock, Homestead and Duquesne amount to about \$4,000,000.

AT the request of State School Commissioner, John T. Glen, according to the *Boston Transcript*, Professor C. M. Strahan, of the State University, has drawn a map of Georgia, which shows the location and number of every common school (white and black), high school, college and university in the State. The map is twelve by ten feet and is the largest map of Georgia ever drawn.

THE annual meeting of the New Jersey Forestry Association was held in Lakewood on November 8th and 9th. A lecture was given by Dr. J. T. Rothrock on 'The Relation of Forests to the Surface of the Country,' and there were special discussions on the prevention of forest fires and the preservation of the Palisades.

THE Columbia University Press will publish shortly a life of the late President F. A. P. Barnard, prepared by John Fulton, of Philadelphia, at the request of Mrs. Barnard. The author had complete access to all Dr. Barnard's letters and papers, and traces his educational career in the South, as well as the development of Columbia College under his presidency.

A BRONZE bust, by Mr. D. W. Stevenson, of the distinguished botanist, Dr. Robert Brown, has been unveiled in his native town, Montrose, Forfarshire, Scotland. The bust is accompanied by a tablet bearing the inscription: "Robert Brown, D.C.L. Oxon, L.L.D. Edin., F.R.S. Lond., President of the Linnean Society, Member of the Institute of France. Born in this house 21st December, 1773; died in London 10th June, 1858. 'Botanicorum facile princeps.' Alex. von Humboldt."

THE death is announced in Usambara of Dr. Stapff, the geologist who, at the request of the German East Africa Company, proceeded a few months ago to East Africa in order to prospect for gold.

FATHER HURST, known for his contributions to archaeology, died recently in his 53d year.

THE death is announced of Prof. Herman Hellriegel, the well-known agriculturist, at the age of 63. Most of his researches were concerned with chemical and physiological questions relating to the nutrition of plants. His chief discovery, which was communicated to the agricultural chemistry section of the *Naturforscher Versammlung* in 1886, was the fixation of gaseous nitrogen by leguminous plants through the medium of their root nodules. Dr. Hellriegel was an honorary member of the Royal Agricultural Society of England, and a foreign associate of the Société Nationale d'Agriculture of Paris.

THE fifth centenary of the birth of Gutenberg will be celebrated in 1897 by the city of Mayence.

THE new session of the Royal Geographical Society will be opened on November 11th, when, after a short opening address by the President, Mr. A. Montefiore, will give an account of the progress of the Jackson-Harmsworth Expedition. At the second meeting Dr. K. Grossmann will give an account of the results of his recent visit to the Faeroe Islands, and at the December meeting the Rev. Walter Weston will describe his explorations in the Central Alps of Japan. All the papers will be fully illustrated by means of the lantern. After Christmas among other papers that may be expected are the following: 'Various Movements of the Earth's Crust,' by Professor John Milne, F. R. S.; 'British Central Africa, Its Geography and Resources,' by Mr. Alfred Sharpe; 'Exploration in the Alps of New Zealand,' by Mr. E. A. Fitz-

gerald; 'Our Knowledge of the Oceans,' by Dr. John Murray; 'The Geography of the English Lake District,' by Mr. J. E. Marr, F. R. S. It is hoped that Mr. and Mrs. Littledale will have returned from their adventurous journey across Central Asia before the end of the session and will give to the Society an account of their travels. The afternoon meetings in the map room, begun last session, will be resumed during the present session. Among the subjects to be brought forward for discussion will be: 'The Construction and Uses of Globes,' by Mr. J. Y. Buchanan, F. R. S.; 'The Struggle for Life in the North Polar Region,' by Mr. A. Trevor-Battye; 'An attempt to Reconstruct the Maps of Herodotus,' by J. L. Miers.

M. B. C., PERTH AMBOY, N. J., writes to the New York *Evening Post*, as follows:

"My mother—a sister of Gen. Meade—was born in Spain, and lived there until she was four years old, at which time her parents returned to this country and settled in Philadelphia. For some years Spanish was the only language spoken in the family; but when old enough my mother and her sisters were placed at Madame Ségoing's boarding school, which in the early part of the century was one of the most famous schools in the country. There she finished her education, and throughout her life had perfect control of the French language. The Spanish, however, she entirely forgot. My mother's last illness was tedious, her mind becoming gradually weakened; but long after she had ceased to speak English she would talk fluently in French. Then there came an interval towards the close of her life when she did not speak at all; but the last few words of all were—Spanish!" Cases have been previously reported in which a person in his last illness has used the long forgotten language of childhood, but the above case is of interest owing to the use of an intermediate language."

UNIVERSITY AND EDUCATIONAL NEWS.

MR. JOHN D. ROCKEFELLER has given an additional million dollars and a contingent contribution of two million dollars to the University of Chicago. His letter to the trustees is as follows:

OCTOBER 30, 1895.

To the Trustees of the University of Chicago, T. W. Goodspeed, D. D., Secretary.

GENTLEMEN: I will contribute to the University of Chicago \$1,000,000 for endowment, payable January 1, 1896, in cash, or at my option, in approved interest-bearing securities at their fair market value.

I will contribute in addition, \$2,000,000 for endowment or otherwise, as I may designate, payable in cash, or, at my option, in approved interest-bearing securities at their fair market value, but only in amounts equal to the contributions of others, in cash or its equivalent not hitherto promised, as the same shall be received by the university. This pledge shall be void as to any portion of the sum herein promised, which shall prove not to be payable on the above terms, on or before January 1, 1900.

Yours very truly,

(Signed)

JOHN D. ROCKEFELLER.

These gifts will make the entire amount of Mr. Rockefeller's donations to the University of Chicago about \$7,600,000, probably the largest gift ever made by an individual for educational or public purposes.

PROFESSOR GEORGE W. SMITH was to have been installed as President of Colgate University on November 14th. President Gilman was to deliver the principal address, and other prominent educators signified their intention of being present.

THE University of Minnesota has five new buildings nearly completed. They are (1) Medical Laboratories (\$40,000); (2) Armory (\$100,000); (3) Dairy Laboratories (\$30,000); (4) Dining Hall and Dormitory for School of Agriculture (\$30,000) and (5) Astronomical Observatory (\$10,000). The new die-testing works (\$25,000) are this year opened for experimental work.

THE University of Kansas began its thirtieth year September 5th. Owing to the absence of Chancellor F. H. Snow the

formal opening exercises were postponed until October 4th. On that date James Willis Gleed delivered the opening address. The University year opens with an enrollment of 725 students, divided among the five schools of which the University is composed as follows: Arts, 420; Law, 101; Pharmacy, 58; Engineering, 86, and Fine Arts, 63. This is an increase of a hundred over last year.

THE new Physics and Electrical Engineering building of the University of Kansas, finished during the summer, is now occupied by the physics department. This building has been erected by the State, and is designed for physical work and especially for research in electricity. The head of this department is Dr. Lucien I. Blake, best known by reason of his experiments for the United States government in establishing telephonic communication between the light ships of the Atlantic coast and the adjacent shores. W. N. Whitten, University of Michigan, '95, has been elected assistant in the chemical laboratories during the absence of E. H. S. Bailey, head of the department. Prof. Bailey has been granted leave of absence for study in Europe during the fall term. Owing to the crowded conditions of the chemical laboratories it has been necessary to fit up additional desks in the main building, to which all work in organic chemistry will be transferred.

PROFESSOR EDWARD GRANT CONKLIN, of the Northwestern University, of Evanston, Ill., has been elected professor of comparative embryology in the University of Pennsylvania, in place of the late Dr. John Ryder. Dr. Harrison Allen, who recently resigned the directorship of the Wistar Museum, has been made emeritus professor of comparative anatomy.

THE committee engaged in raising funds for the Women's College, in connection with Brown University, have raised \$20,-

000 of the \$50,000 required for the erection of a building.

MR. ANDREW CARNEGIE has given Williams College \$900 to free the infirmary from debt.

EDWARD PIERCE, PH. D. (Harvard), has been appointed instructor in psychology in the University of Michigan.

V. L. LEIGHTON, last year assistant in the chemical laboratory of the University of Kansas, has been called to a similar position in Tufts College, Mass.

THE annual meeting of the New England colleges was held at Hanover, N. H., (Dartmouth College) on November 7th and 8th. The institutions represented by delegates, including in nearly all cases the presidents, were Harvard, Yale, Brown, Williams, Amherst, Trinity, Wesleyan, Tufts, Boston, Bowdoin, Clark, Vermont and Dartmouth.

AN association of colleges and academies of the Southern States was formed at Atlanta on November 7th, representing fourteen institutions.

THE friends of Mrs. Agassiz have contributed \$6,000 to Radcliffe College to be used for the establishment of an Elizabeth Cary Agassiz Scholarship.

DR. GALLE, professor of astronomy at the University of Breslau and director of the observatory, has resigned.

DR. KLINGER, professor of chemistry at the University at Bonn, has received a call to the University of Königsberg.

THE electrical and anatomical institutes founded by M. Ernest Solvay and presented by him and other donors to the University of Brussels, were officially inaugurated on October 30, under the Presidency of the Burgomaster, assisted by M. Graux, the Chancellor, and the entire body of professors. Delegations from the English and Continental universities responded to the

invitation of the Brussels University to take part in the series of *fêtes* organized in celebration of the event.

DISCUSSION AND CORRESPONDENCE.

THE INTERNATIONAL CODE OF NOMENCLATURE.

UPON reading the statement that the *Third International Zoological Congress* has appointed an International Commission of five members to study the different codes of nomenclature proposed and adopted in various countries, some zoölogists may immediately draw the conclusion that it is the intention to overturn (or rather to *attempt* to overturn!) existing and well established practices in nomenclature. One or two persons with whom I have talked upon the subject did, in fact, have this impression. In order to dispel such thoughts from any and all minds in which they may arise, I desire to state definitely that no such plan was contemplated by Geheimrath Schulze (Berlin) when he made his proposition, nor by the Congress when the proposition was adopted. Furthermore, from what I know personally of the men on the Commission, it can be positively stated that such an idea is very far from their thoughts.

Every one will admit that there are points in the International Code upon which differences of opinion exist; that different interpretations of the code have been made in various countries; that the *arrangement* of the code has been criticized in some quarters; that some of the translations of the code have not been all that could be desired in the way of exactness; and that in various countries differences of opinion exist upon some points which are not included in the present international code.

The objects Prof. Schulze had in making his proposition were to submit all of these points to investigation by an international committee; to have an authorized edition of the code in English, French and German; to add points which had been omitted; to better the code where this can be done; and to embody the results of this study in a report to be presented to the next International Congress.

I would further call attention to the fact that the report of this commission is not final, but

is subject to the action of the next International Congress, to be held in Great Britain in 1898.

A large edition of the International Code has been issued by the Société Zoologique de France for general distribution, and any working zoölogist may obtain a copy of it by addressing the Secretary, Prof. Raphael Blanchard, 32 rue du Luxembourg, Paris, France.

Should any American zoölogist have any suggestions to make in regard to additions, amendments, etc., to this Code I request him to communicate with me before September 1, 1896.

There are a few points in this Code with which perhaps the majority of American zoölogists are not in sympathy. 'The majority of American zoölogists,' however, does not mean 'the majority of the zoölogists of the world,' and while it is beyond question that a view expressed by the majority of workers in this country will receive the utmost consideration, we must not forget that the next International Congress cannot be expected to repeal the present International Code and adopt an American, French, German or English Code in its place, but must stand by international decision upon all questions in regard to which differences of opinion exist.

It is my intention to request the National Academy, The Smithsonian Institution, the Society of American Naturalists, the American Ornithologists' Union, the American Association for the Advancement of Science and the Royal Society of Canada, each to appoint one of its members as a representative upon an Advisory Committee to which I may submit for approval or disapproval all of the questions which I intend to support in the meetings of the International Commission, and with which I may advise regarding concessions to be made or requested in those points upon which American opinion differs from the views held in some of the other countries. It is needless to add that my vote in the International Commission will be determined by the action of this Advisory Committee, should the occasion arise that my personal opinion upon any particular point differs from the opinion of the gentlemen appointed to advise me.

CH. WARDELL STILES,

B. A. I., U. S. Dept. Agriculture.

WASHINGTON, D. C.

KATYDID ORCHESTRATION.

TO THE EDITOR OF SCIENCE: I am interested in the notes lately published in SCIENCE on this subject, and should be very glad to have the insect described by Mr. Gould identified, for my own information. This is because, during two summers spent at Cranberry, in the mountains of North Carolina, not far from Roan Mountain, I continually heard the same music Mr. Gould describes, and have no doubt that my insect and his are the same. Supposing it to be, of course, well known to entomologists, I preserved no specimens, and only remember being struck by the very small size of those I handled. It is certainly not the common *Katydid*, *Cyrtophyllum concavum*. Aside from the almost deafening noise which seemed, as it were, to make the trees tremble, what struck me most was the punctuality with which the orchestra tuned up at a particular time near sunset, the regularity with which the performance continued through the night, and its conclusion at a certain hour in the morning. The inhabitants of the place also speak of the seasonal periodicity of this insect, which is so perfect that they draw certain weather prophecies from its acceleration or retardation of two or three days.

ELLIOTT COUES.

WASHINGTON, 1726 Street.
November 2, 1895.

TO THE EDITOR OF SCIENCE: The antiphonal rhythm of two 'orchestras' of Katydids is so very familiar to me that I was rather surprised to read of it in Dr. Gould's letter of September 20, supposing, as I did, that what I regarded as such an ordinary occurrence must, of course, have been noted and explained by entomologists. But the letters of Prof. Smith and Mr. Scudder in your issue of November 1st imply that such is not the case. My testimony, therefore, may be of some interest. Dr. Gould's description fits exactly the phenomena noticed evening after evening at my home in Montclair, N. J. The 'antiphony' is often very regular for several minutes, sometimes stopping short and again becoming broken into irregular individual stridulation at the end. I have sometimes thought that the exact unison of movement

might be purely mechanical and analogous to the control of one vibrating body by another, the medium of control in this case being the sensitiveness of one insect to the stridulations of another. But the fact that they often start all at once seems to bar out this hypothesis, and, indeed, is a fact difficult to account for in any way.

As to the pitch, it certainly seems as if one 'orchestra' were from a semitone to a tone removed from the other, but, as Mr. Scudder suggests, this may be only apparent. In case it is real, however, may it not be due to the falling into beat of each insect with those to whose stridulation it is most sensitive—namely, those that produce sounds approximating to its own in pitch?

ARTHUR P. BOSTWICK.

NEW YORK, November 5th.

THE SCIENCE OF MENTATION.

EDITOR OF SCIENCE: Some time since a reference was made in SCIENCE to a paper published with the above title in the *Monist* for July. The author was reported to have studied by experimental methods the development of certain forms of 'mentation' in dogs. As I have been greatly interested in the subject of comparative psychology for years, and have myself been devoting much time to the study of the psychic development of animals from birth onward with investigation of the contemporaneous changes of a physical kind especially in the brain, I looked up the article referred to, written by Mr. Elmer Gates. Many of the statements and conclusions are of so remarkable a character that I should be glad to get further information, as would, no doubt, others also. We are told that seven shepherd puppies were confined in a completely darkened room for nine months; that the mother was permitted to go in and out; but we are not informed as to whether the mother was admitted for the sole purpose of suckling the puppies, though this is the natural inference. Now, if a dam is capable of supplying seven puppies at nine months of age with all the nourishment they require, as one specially interested in dogs and who has for years made a special study of these animals and bred them extensively, I should like to know the facts; for nothing of like kind is, so far as I am

aware, on record, and on the face of it I should doubt the possibility of such a thing. I see no necessity for any such drain on the dam, yet Mr. Gates' paper leaves the matter in doubt.

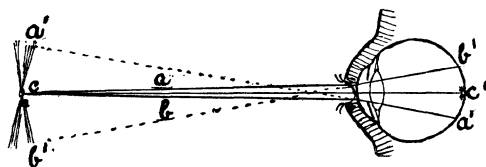
Again, though the most sweeping conclusions are drawn as to results both positive and negative following functional use and disuse, of certain portions of the organism, and though these experiments stand almost or quite alone, but meagre details are given either of the experiments or the anatomical appearances, and not a single illustration either diagrammatic or other accompanies the paper, nor is there any intimation that such details or illustrations have been or are to be published elsewhere. I should like to point out that such work is of but little use to scientific men in its present form, for at best it is only suggestive, not demonstrative. It is to be hoped that if Mr. Elmer Gates can furnish the details and illustrations necessary to meet scientific requirements he will lose no time in doing so, as, if his experiments, etc., are reliable and his conclusions correct, they are not only of great scientific interest but of much practical importance to educationists and others. Mr. Gates' paper abounds in very stimulating 'mentation,' and much of it seems to fit very naturally into my own mental moulds. In asking for more details I think that I am writing in the interests of a large class of scientists and others.

WESLEY MILLS.

PHYSIOLOGICAL LABORATORY,
MCGILL UNIVERSITY, MONTREAL.

INVERTED IMAGE ONCE MORE.

IF Prof. Woodworth (see SCIENCE, October 25, p. 555) will look into my little volume on *Sight*, pp. 87 and 88, he will find described and explained not only the phenomena he refers to, but all his experiments with the lids. I have been familiar with the phenomena all my life, but first described and explained it in 1871 (see *Phil. Mag.*, Vol. LXI., p. 266, 1871). I afterwards discovered that it had been previously explained by Priestley. It is not due to imperfect accommodation, as Prof. Cattell thinks, but to *refraction by the concave watery meniscus between the two lids and the surface of the cornea*. The following figure will explain itself and the phenomena in question. The central ray c c'



from a candle passes straight to the retina as usual and forms the image on the central spot of the retina, but the upper marginal rays *a* are refracted upward to *b'* on the retina and the lower marginal rays *b* to *a'*. These are referred back by the law of direction as shown by the dotted lines.

JOSEPH LE CONTE.

BERKELEY, October 30th, 1895.

Professor Le Conte describes one of the imperfections in the dioptric apparatus which lead to the formation of entoptic rays of light. In my note to which he refers I only noticed the inversion of the image, and did not attempt to describe the various defects which cause the dispersion of light, only saying, in agreement with Professor Le Conte; that "the light from a gas jet passing through the lower half of the pupil is in part refracted downward, affects the lower half of the retina, and is projected as rays extending upward." Professor Le Conte's explanation accounts for the vertical dispersal of light when the eyelids are partly closed, but there are other defects in accommodation which lead us to represent a 'star' not by $\cdot$ but by $*$.

I almost hesitate to refer again to the inverted image on the retina. The phenomenon is explained so clearly by Berkeley in his *New Theory of Vision* that it ought not to have been regarded as a puzzle since 1709. What Professor Le Conte has written on the subject in his suggestive and valuable book on *Sight* and recently in this JOURNAL (p. 629 of this volume) seems to me beside the mark. Our notions of up and down come from sensations of touch and movement. A visual image can only be erect or inverted in reference to other visual images—not in reference to entirely disparate sensations of touch and movement. The image of a man on the retina has the feet towards the image of the ground, and this is what we mean by being erect. The retinal image is in any case

only a link in a chain of physical processes. We do not know how the nerve fibres from the retina are distributed in the brain, but it is highly improbable that they end in a surface or reconstruct in any way a picture or a model of the external world.

J. MCKEEN CATTELL.

SCIENTIFIC LITERATURE.

British Association for the Advancement of Science (Ipswich, 1895). Tenth Report on the Northwestern Tribes of Canada. Fifth Report on the Indians of British Columbia. By FRANZ BOAS. 71 pp. 8vo.

This final report of Dr. Boas concludes the investigations, initiated in 1884, which have added so much to our knowledge of the social condition, mental and physical characteristics, languages and institutions of the northwestern tribes of the Dominion of Canada. The main portion of the report is concerned with an account, excellent in detail of presentation, of the 'Physical Characteristics of the Tribes of the North Pacific coast (pages 3-30, besides 11 tables of anthropometric data, and many lesser tables in the text)', we have besides notes on the Tinneh tribe of Portland Canal, the Tinneh tribe of Nicola Valley, the Nass River, and brief accounts of the Niská (closely related to Tsimshian), and the Ts' Ets' á út (a Tinneh dialect).

The value and extent of Dr. Boas' contributions to the physical anthropology of the Indians of the northwest coast may be estimated from the fact that the eleven tables alone contain the individual measurement (12 in each case) of some 500 Indians belonging to about a dozen tribes, or subtribes, and to several distinct linguistic stocks. The author's chief conclusions as to physical characteristics are as follows:

1. There is a gradual decrease in stature as we go southward along the coast from Alaska to Frazer River—the Tlingit averaging 173 cm., the Indians on the shore of Harrison Lake only 158 cm. As we go southward the stature increases again, but its distribution becomes very irregular. Somewhere between Vancouver Island and the Skeena River a very material change of type takes place. Dr. Boas shows

clearly the uniformity of the Kwakiutl group of tribes, and incidentally notes that it is clearly shown that "a strong deformation of the kind practiced by the Kwakiutl increases the length of head and diminishes the breadth of head; but moderate degrees of deformation do not influence materially the lower portion of the skull in which the greatest width of the head is found." The dimensions of the face seem uninfluenced also.

2. This distribution of stature Dr. Boas considers as being incapable of being explained by difference of food supply or mode of life, but is due to 'a slow permeation of the tall tribes of the North and of the short tribes of Fraser River.'

3. From the study of the British Columbian tribes, as well as from his general survey of the Indians of the whole of North America, the author finds that the "proportionate difference between the stature of men and women is the less the smaller the people," and that "the women of the short tribes of the Pacific coast seem to be taller than those of the short tribes of other regions."

4. Four types must be distinguished on the coast of British Columbia: (1) Nass River Indian type; (2) Kwakiutl type; (3) type of Harrison Lake and Salish of the interior; (4) type of the Okanagan, Flathead and Shuswap. The Nass River Indians have a face "the breadth of which (156.5) may be called enormous, as it exceeds the average breadth of face of the North American Indian by 6 mm." The face of the Kwakiutl is marked by its enormous height; while the nose is characteristic. The Harrison Lake Indians have "a head exceedingly short and broad, surpassing in this respect all other forms known to exist in North America." The head of the Shuswap is "shorter than that of the tribes of northern British Columbia, or of the Indians of the Plains." Dr. Boas justly remarks the difficulty in comparing descriptive features, "on account of the large personal equation of the observers, and even of the same observer at different times."

5. Among the tribes, of Fraser River "children seem to be much more brachycephalic than adults." The author remarks, however: "Investigations carried on by means of exten-

sive material do not show any such differences, and it is likely that more extended investigations would cause the apparent difference to disappear; but it is also possible that in this region we may find the length of head to increase more rapidly than the breadth of head. Among the Eastern Indians, and in different parts of Europe, we find a slight decrease of the cephalic index with increasing age, but in no case does the difference exceed one per cent. We also find that the heads of women are somewhat shorter than those of men."

6. "The cephalic index decreases rapidly as we go up Fraser River, but is higher among the Shuswap than among the Nkamtcinemuq. The facial index increases quite regularly from Harrison Lake to the Shuswap, but we must remember that the face of the Ntlakyāpamuq'ō'e is much smaller than that of the Shuswap and that of the lower divisions of the Ntlakyā'pamuq. The nasal index is so variable that we cannot draw any conclusions from its average values."

7. The Ntlakyā'pamuq'ō'e, while speaking one language, offer "an excellent example of the fact that linguistic and anatomical classifications do not follow the same lines"—being a people of mixed blood.

A very interesting section of the report is that which deals with the average number of children per mother among certain of the British Columbian tribes—the Kwakiutl especially. Of the latter Dr. Boas says: "The maximum sterility is found among women who are now from forty to fifty years old, that is who became mature about twenty-five or thirty years ago. This agrees very closely with the time when the Kwakiutl sent their women most extensively to Victoria for purposes of prostitution. During the last decade a number of influential men among the tribe have set their influence against this practice, and we see at the same time a rapid increase in the number of children. The young women who have now an average number of 2.7 children, may hope to regain the number of children which their grandmothers had. But the only hope of preserving the life of the tribe lies in the most rigid suppression of these visits of women to Victoria, which are still continued to a considerable extent, and in an effort to stamp

out the diseases which have been caused by these visits."

Pages 30-34 are taken up with notes on the Tinneh tribe of Nicola Valley, now extinct, whose language Dr. Boas shows "was much more closely related to the Tinneh languages of British Columbia than to those farther south, although it would seem to have differed from the former also considerably." A noteworthy addition to our knowledge of British Columbian peoples is the sketch of the Ts'ets'á'ut, first scientifically studied by Dr. Boas (pp. 34-48) and of the Niská (pp. 49-62), details of whose sociology and folk-lore, etc., are given. The linguistics of the report (pp. 62-71), though not extensive, are new and valuable. Taken all together this excellent report fitly crowns the work of the committee under whose auspices these investigations were inaugurated. It is sincerely to be hoped that some way will be found to continue researches that have been productive of such great results and added so much to American anthropology and linguistics.

ALEX. F. CHAMBERLAIN.

Solution and Electrolysis. By W. C. D. WET-
HAM, M. A. Macmillan & Co., London and
New York. Price \$1.90.

This book forms one of the physical series of the Cambridge Natural Science Manuals. It gives a summary of the work which has been done up to the present time, but particularly during the last twenty years, on the physical properties of solutions. This subject forms a branch of physical chemistry which has, within the last few years, attracted towards it a number of eminent investigators, who have obtained results of great interest and importance. To the student of the properties of matter it is difficult to conceive of any more fascinating branch of study than that of diffusion, osmotic pressure, the influence of dissolved substances on the freezing point, boiling point and vapor pressure of solvents, and the very curious difference between electrolytic and non-electrolytic solutions. The subject is only beginning to crystallize and few systematic treatises, and these mostly German, are devoted to it. The present work will therefore be welcomed by readers who prefer works written in the English language. It gives

in brief form an account of the results so far arrived at and the theories towards which they point. This summary will no doubt prove of great service to students and also to physicists and chemists who have not followed the investigations in the publications of scientific societies and the journals.

The treatment of the subject is perhaps rather too brief, but outside of that the presentation of the subject is good and the printing is, as usual, very satisfactory. A few instances of somewhat careless statement exist as, for instance, the statement of the thermodynamic cycle on p. 26, which is incomplete. This is unfortunate, because everything with regard to the second law of thermodynamics seems to be a source of difficulty to students. Again, the references are occasionally misleading. Take, for example, that to Jahn's work on the Peltier effect given on p. 117. Most students would interpret it to mean that the idea of testing contact difference of potential through Peltier's effect originated with Jahn, whereas it has been in the minds of physicists and has given rise to discussion for forty years or more.

The paragraph on p. 204 on the explanation of the possible effect of specific inductive capacity on ionization power seems unsatisfactory. To any one who requires an explanation that given is probably useless.

Fitzpatrick's tables on the 'electro-chemical properties of solutions,' originally printed in the British Association proceedings, are given in an appendix and will no doubt be welcomed by many.

The book is well worth perusal and is a valuable addition to our works on physics and chemistry.

THOMAS GRAY.

Critical Periods in the History of the Earth. By JOSEPH LE CONTE. Bulletin Dept. Geology, University of California. Vol. I., No. 11, pp. 313-336. Berkeley, August, 1895. (Reprinted.)

This is, in a somewhat condensed form, the address which opened the discussion, by the Congress of Geologists at Chicago, August, 1893, on the question "Are there any natural divisions of the geological record which are of world-wide extent?" The author begins with a brief refer-

ence to the cataclysmic and supernatural origin ideas of the early geologists and with tributes to Lyell and Darwin as the exponents of uniformitarianism and evolution. The present status of thought is defined to be 'that of gradual evolution both of the earth and of organic forms, but *not at a uniform rate.*' In other words, we now recognize that the laws and forces of nature work not as along a rigid line but so that the effects are cyclical, and the questions to be solved are how far the changes produced, or some of them have been general, instead of local, and may they or any of them be used to determine the division or subdivision of geological history for the whole earth? The adaptation of the European standards of classification were found difficult or impossible for other parts of the world, which led to the idea, against which the author raises a warning voice, that *all* changes are local. The author claims that there have been 'critical periods' in the earth's history—physical changes so great as to affect the climates of the earth as a whole and to cause marked changes in organic forms. The physical changes compel organic changes largely by inducing or compelling migration of species, thus bringing about new environments and new struggles for existence between faunas and floras.

Amongst the signs of such critical periods are mentioned widespread unconformities; sudden changes in organic forms, affecting not only species but sometimes genera and families; the introduction of new and higher dominant classes; the birth of great mountain ranges. Of these the most general and important are considered to be represented by changes in organic forms. This is, therefore, adopted for determining the primary divisions of geologic time. Secondary divisions are based on less general changes and are more local in their application.

Even the greatest changes are not to be considered as catastrophic. They were not instantaneous or simultaneous, but probably extended through hundreds of thousands of years and were propagated gradually from place to place.

Four such critical periods or revolutions are mentioned. I. The Glacial, in which the physical cause was the great change in climate and

the attendant oscillations of level, leading to wide migrations and extinctions of organic forms and the appearance of man. II. The Post-Cretaceous, or Rocky Mountain, which resulted in the obliteration of the interior cretaceous sea and the unification of the American continent, during which mammalian life was evolved, and of which the Laramie may be considered as the transition period. III. The Post-Palæozoic, or Appalachian, of which the Permian may be considered the transition period, and which brought about the greatest change in life-forms that is recorded in geologic history. Amongst the physical changes which brought these about are mentioned the evident *oscillations* of temperature, including even well defined and extensive periods of glaciation. IV. The Pre-Cambrian. This is marked principally in the rock system by universal unconformity, as the life system was such an inconspicuous element in those early times.

We should therefore have practically the divisions as now recognized, beginning with the earliest. Eozoic, up to the Cambrian period; Paleozoic, up to the Triassic, with the Permian as a transition epoch; Mesozoic, up to the Tertiary, with the Laramie as a transition epoch; Neozoic, up to the advent of the Ice age, and finally all time from them to the present.

The author notes that these critical periods have become gradually shorter and shorter, the changes in physical geography less and less, and in consequence the changes in organic forms less and less. The shortest in duration, the least in geographical changes, and the least complete and sweeping in changes of organic forms is the last; but the effect of the introduction of new dominant types in producing changes has been steadily increasing, as witness the appearance of man. Also the oscillations of temperature at critical periods have increased with time.

The subject closes with a discussion of the laws of evolution of the organic world and the suddenness of changes and variety of transitional forms. As a type in this latter connection is quoted the change which occurred between Paleozoic and Mesozoic times, which is accounted for partly by loss of the record and

partly by probable exceptional rapidity of evolution, the more rapid extinction of old forms and the comparative paucity of newly evolved forms, hence the poverty of fossils.

In a brief review of a confessedly concentrated dissertation it is not possible to do more than merely outline its scope. The paper is one the principal importance of which lies in the significance of its hints rather than in its finished conclusions.

ARTHUR HOLLICK.

The Practice of Massage: Its Physiological Effects and Therapeutic Uses. By A. SYMONS ECCLES, M. B. ABERD., M. R. C. S., England. London, Macmillan & Co. 1895. 8vo. Price \$2.50.

It is evident at a glance that the author is a man who can see and think as well as rub. He deals largely with the philosophy of massage and presents his observations in a very plain and comprehensive manner. The book is not a manual for the manipulator so much as a physiological treatise suggesting to the reader the wide scope for the employment of massage and the precise manner in which it acts in given cases.

The text is enriched by ample references to the best and latest literature in which full credit is given to American authors. Among other affections massage is strongly advocated for the treatment of "Golf-hip" an accident which the author was the first to describe. It is a condition of gluteal strain occurring as the result of over-vigorous employment of the 'driving stroke,' and perhaps associated with a lack of skill in neophytes. One of Mr. Eccles' patients had within ten days of his accident been learning to play golf and had devoted the greater part of an afternoon to the practice of a stroke involving an attitude and a rapid muscular effort; desiring to pose, while driving a 'tee'd ball,' in the most finished style, he felt a violent pain in the upper and outer part of the buttock and over the right lumbar region, so that on leaving the ground he was unable to walk without much suffering and could not stand erect. Massage cured him, as it will sufferers from a sprained ankle, the lawn tennis elbow and similar accidents. The author claims that massage is a great but neglected

adjuvant in the treatment of fractures but he goes too far when he says: "Excellent results have been obtained without muscular atrophy in fractures of the patella and leg bones, locomotion without support, save from a stick, being acquired in a fortnight."

In applying massage in medical cases, on the other hand, he wisely says that "Impatience is the stumbling-block most readily impeding recovery, and unless this can be curbed success will not attend the methods advocated." "Unfortunately no method of treatment can be vaunted as a cure for deficiency of moral courage." Massage, however, is a great help in the treatment of the morphia and alcohol habits. It is also advocated by the writer for the 'strychnia habit,' a condition not observed, so far as we know, in America.

As Great Britain has signified her acceptance of the metric system, we hope that future editions of this valuable work will discard the use of 'stones,' with pounds in favor of something more intelligible for readers the world over.

GUY HINSDALE.

NEW BOOKS.

Neue Versuche zum Saison — Dimorphismus der Schmetterlinge. AUGUST WEISMANN. Jena, Gustav Fischer. 1895. Pp. 74. M. 1.50.

Neue Gedanken zur Vererbungsfrage eine Antwort an Herbert Spencer. AUGUST WEISMANN. Jena, Gustav Fischer. 1895. Pp. 72. M. 1.50.

Anleitung zur Mikrochemischen Analyse. H. BEHRENS. Hamburg and Leipzig, Leopold Voss. 1895. Pp. viii + 64.

Elektricität und Licht. O. LEHMANN. Braunschweig, Vieweg und Sohn. 1895. Pp. xv. + 390. M. 7.00.

Atlas d'Ostéologie. CH. DEBIERRE. Paris, Félix Alcan. 1895. Pp. viii + 92. 12 fr.

Missouri Geological Survey. Vol. III. CHARLES R. KEYES. Jefferson City. 1895. Pp. 405.

Anarchy or Government. WILLIAM MACKINTIRE SALLER. New York & Boston, Thomas T. Crowell & Co. Pp. viii + 177. 75 cents.

Etidorhpa, The End of the Earth. JOHN URI LLOYD. Pp. 376.